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March 1988

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NEW RECORDS OF MIDDLE MIOCENE ANSERIFORM BIRDS

FROM KERN COUNTY, CALIFORNIA

By

Hildegarde Howard

NEW RECORDS OF MIDDLE MIOCENE ANSERIFORM BIRDS
FROM KERN COUNTY, CALIFORNIA

By

Hildegarde Howard¹

ABSTRACT. Previously unreported anseriform bones now available from the Middle Miocene Sharktooth Hill Bonebed reveal the presence of a large species with adaptations for diving not evidenced in the previously described Presbychen abavus Wetmore, 1930. The new form is described, on the basis of four specimens, as Megalodytes morejohni new genus and species. The remaining specimens are discussed as Megalodytes sp. and Anseriformes spp. The ulna previously referred (Miller 1961) to Branta sp. is included in the latter category. Megalodytes morejohni appears to have been a swan-like anserine, while Presbychen abavus was goose-like.

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900 Exposition Blvd., Los Angeles, California 90007.

INTRODUCTION

The Middle Miocene Sharktooth Hill Bonebed is a rich fossil deposit in the upper part of the Round Mountain Silt in Kern County, California. This bonebed is exposed near the Kern River, approximately 8 to 10 miles northeast of Bakersfield, and has yielded the most diverse and best studied Tertiary fossil marine vertebrate assemblage yet known from anywhere within the Pacific realm (Mitchell, 1966; Barnes, 1976; Barnes and Mitchell, 1984). The fossil assemblage has been named the Sharktooth Hill Local Fauna (Wood, et al., 1941), and is comprised of more than one hundred species of sharks, bony fish, turtles, birds and mammals, including the rare fossils of some terrestrial mammals, reptiles, and birds that originated from the adjacent Miocene land mass. Some of the fossils to be described in this report were derived from outcrops of the bonebed adjacent to the Sharktooth Hill National Natural Landmark, as established by the National Park Service in 1976.

The Sharktooth Hill Bonebed is a single, relatively thin, but laterally widespread horizon. It has been correlated with the Barstovian North American Land Mammal Age, and with the "Temblor" provisional provincial mega-invertebrate stage of Addicott (1972), and is, therefore, between approximately 13 and 15 million years old (Wood, et al., 1941; Mitchell, 1966; Barnes, 1976; Barnes and Mitchell, 1984:4).

Bones of fossil birds are rare in this deposit, but are in a relatively good state of preservation, even when interspersed amid larger, sometimes broken and abraded bones of mammals and other vertebrates. Fifteen avian taxa have been previously reported from the Sharktooth Hill Local Fauna (Howard, 1984). These include two large anseriform birds: Presbychen abavus Wetmore, 1930 and Branta sp. (Miller, 1961). The latter record is based on a single proximal end of an ulna in the collections of the Museum of Paleontology at the University of

California, Berkeley (UCMP no. 95970).

The holotype of Presbychen abavus is the distal end of a right tibiotarsus in the United States National Museum (USNM no. 11973). As described by Wetmore (1930:93), the specimen is "strongly suggestive of the modern Canada Goose," and "intermediate in dimension between the largest of the Canada geese and the whistling swan." Over thirty years later, the species was again cited from the Sharktooth Hill Local Fauna (Howard, 1966) with the assignment of a proximal end of a tarsometatarsus and, questionably, a fragmentary proximal end of a femur. Both of these specimens are in the collections of the Natural History Museum of Los Angeles County (LACM nos. 16466 and 16465).

In the early 1970's, Dr. G. Victor Morejohn of the California State University, San Jose, was studying the Sharktooth Hill anseriform material in the collections of the University of California, Museum of Paleontology, in Berkeley. In a letter to me dated 25 March 1974, he indicated that he interpreted the proximal end of a humerus (UCMP 93050) to be in several ways more similar to that of the fossil diving duck, Chendytes, L. Miller, 1925, than to the geese or swans. He added that a proximal fragment of tibiotarsus on loan to him from the Natural History Museum of Los Angeles County (LACM 34530) was also suggestive of Chendytes.

Fourteen anseriform bones are now known from the Sharktooth Hill Bonebed, including the previously recorded material (Wetmore, 1930; Miller, 1961; and Howard, 1966), the bones noted by Morejohn, and an additional eight specimens not previously ~~before~~ studied. Among the latter is a nearly complete tibiotarsus (LACM 123991) collected in 1982 from LACM locality 4956, near the Sharktooth Hill National Natural Landmark. This specimen provides the opportunity to compare the distal end with the holotype of Presbychen abavus. The comparison clearly indicates distinction, with the proximal end showing characters associated with the diving anseriforms. Very closely associated in the same quarry were two

femora (LACM 123992 and 123993) and a fragment of a humerus (LACM 123995) of a large diving anseriform. The present paper provides a description of a new genus and species based on this material. The possible relationship of other Sharktooth Hill anseriform specimens to this new genus is discussed.

METHODS AND MATERIALS

Acronyms used for institutions are:

LACM: Natural History Museum of Los Angeles County

UCMP: University of California, Berkeley, Museum of Paleontology

USNM: National Museum of Natural History, Smithsonian Institution

Anseriform material now available from Sharktooth Hill

Recorded Material

Presbychen abavus Wetmore 1930

Holotype (cast) distal end of tibiotarsus, USNM 11973

Referred proximal end of tarsometatarsus, LACM 16466 (Howard 1966)

Referred proximal end of right femur, LACM 16465 (Howard, 1966)

Branta sp. (Miller, 1961)

Proximal end of ulna, UCMP 95970

Material examined by Morejohn (unrecorded)

Proximal end of right humerus, UCMP 93050, loc. V71013

Proximal end of left tibiotarsus, LACM 34530, loc. 1625

Additional unrecorded material

Nearly complete left tibiotarsus, LACM 123991, loc. 4956

Nearly complete left femur, LACM 123992, loc. 4956

Nearly complete right femur, LACM 123993, loc. 4956

Incomplete left femur, LACM 123994, loc. 4956

Proximal fragment of right humerus, LACM 123995, loc. 4956

Proximal end of right humerus, LACM 122979, loc. 3162

Left tarsometatarsus lacking distal end, LACM 122981, loc. 3162

Proximal and distal fragments of right tibiotarsus,

UCMP 93051 and 93052, loc. V71013

Skeletons of modern anseriforms used for comparison are in the collections of the Natural History Museum of Los Angeles County.

SYSTEMATICS

ORDER ANSERIFORMES

Family Anatidae

Subfamily Anserinae

Tribe Cygnini

Megalodytes new genus

DIAGNOSIS: Large anserine having ~~t~~^sibiotarsus with distal extension of inner cnemial crest projecting beyond medial edge of shaft and extending distally below level of proximal terminus of fibular crest; anterior surface of shaft very slightly rounded (nearly flat); distinguished from holotype of Presbychen Wetmore, 1930 by greater breadth than depth of condylar area and supratendinal bridge tilted posteriorly along its proximal border; and distinguished from holotype of Chendytes Miller, 1925 by less distal extension of inner cnemial crest, less flattened anterior face of shaft and less flared fibular crest.

TYPE SPECIES: Megalodytes morejohni, new species.

Etymology: From Greek Megalo, large and dytes, diver.

Megalodytes morejohni new species

Figures 1D-F; 2; 3A and D

HOLOTYPE. Left tibiotarsus with eroded proximal surface and incomplete cnemial crests, LACM 123991. Collected by Samuel A. McLeod, 8 May 1982.

REFERRED SPECIMENS. Left and right femora, nearly complete, LACM 123992 (left) and LACM 123993 (right). Proximal fragment of right humerus, LACM 123995.

LOCALITY. LACM locality 4956, quarry grid section 3, Sharktooth Hill Bonebed, Kern County California.

DIAGNOSIS. As for genus.

DESCRIPTION. Both tibiotarsus and femora resemble those of the genus Cygnus in stoutness of shaft. Positions of the ligamental and flexor attachments on the posterior face of the tibiotarsus, and relatively greater breadth than depth of distal end are suggestive of the condition in Cygnus olor (Gmelin, 1789). The anterior face of the shaft is, however, flatter and the extension of the inner cnemial crest is more flared mediad and of greater distal extent, suggesting greater diving ability. Measurements (in millimeters) of holotype tibiotarsus (measurements of Presbychen abavus in parentheses): Length 151.9; breadth of distal end 18.3 (18.6); internal depth of distal end 16.6 (19.0); breadth of incomplete proximal end 16.8; breadth from cnemial crest to fibular crest 14.6.

The femora resemble this element in Cygnus in the nearly straight shaft, when viewed anteriorly, which is greater in lateral breadth than antero-posterior depth. Distally the popliteal area is deeper than in Cygnus or Branta, but less sharply defined than in Merquus. The fibular condyle extends laterad slightly proximal to the external condyle, suggestive of the condition in the diving ducks, Tribe Mergini, but less abruptly protruded. In the Mergini the shaft is more curved and is relatively greater in depth than in breadth. Compared to the proximal fragment of a femur (LACM 16465) previously tentatively referred

(Howard, 1966) to Presbychen, the head is less proximally projected.

Measurements (in mm) of referred femur LACM 123993 (the more complete of the two femora referred to M. morejohni): Length from neck to distal edge of rotular groove 75.4 (same as in LACM 123992); external length 81.0; breadth of distal end 22.6; depth of trochanter 15.2; breadth/depth at middle of shaft 9.5/8.5.

The characters of the referred humerus, LACM 123995, are discussed with those of humeri UCMP 93050 and LACM 122979 under Megalodytes sp.

DISCUSSION. In reporting the distal end of a femur (LACM 125994) of a large diving anatid from the Middle Miocene of Orange County, California (Howard and Barnes, 1987) a relationship ^{to} this Sharktooth Hill anseriform material was _^ postulated. As now studied in more detail, the following distinctions of the Orange County femur from the femora of Megalodytes morejohni are noted: greater antero-posterior than lateral breadth of shaft, more abrupt protrusion of the fibular condyle, and popliteal area more clearly defined externally as well as internally. These characters suggest closer affinity of the Orange County femur to the Tribe Mergini than is evidenced in the femora of Megalodytes morejohni.

Megalodytes sp.

Figures 1 G, H; Figure 3 B, C, E, F,

REFERRED SPECIMENS. Proximal shaft fragment and incomplete distal end with shaft of a right tibiotarsus UCMP 93051 (proximal) and UCMP 93052 (distal); and proximal 3/4 of right humerus (UCMP 93050), all from UCMP locality V71013; proximal fragment of right humerus (LACM 122979) from locality LACM 3162.

DISCUSSION. The distal end of the tibiotarsus (UCMP 93052) resembles that of the holotype of M. morejohni in the posteriorly tilted position of the supratendinal bridge; the proximal portion of the same specimen (UCMP 93051) suggests the same faintly rounded anterior surface of the shaft found in the holotype of M. morejohni. As the condylar area is incomplete both laterally and antero-posteriorly in UCMP 93052, the relative breadth to depth of the distal end

cannot be obtained. In breadth at the level of the supratendinal bridge, and breadth from fibular to cnemial crests, UCMP 93052 and 93051 are approximately 9 percent narrower than the holotype of M. morejohni: breadth at level of bridge UCMP 93052, 13.3 mm (in holotype M. morejohni, 14.5 mm) breadth from fibular to cnemial crests, UCMP 93051, 13.5 mm (in M. morejohni, 14.6 mm).

Humerus UCMP 93050 from the same locality as the tibiotarsal fragments has a capital shaft ridge that is less acute and more lateral in position than in Branta. Resemblance is closer to the humerus of Cygnus in the position of the crest, although it is not as prominent as in the swan. This is true, as well, of humerus LACM 122979. In both humeri, also, the head is not undercut by the capital groove. This character, as well as the presence of the capital shaft ridge, distinguishes these specimens from the humeri of the diving ducks (Tribe Mergini). Suggestive of the condition in the extinct Chendytes is the abrupt palmar receding of the deltoid crest just distal to the external tuberosity, and its sharp reduction after a brief flare. This area is eroded in UCMP 93050, but the outline of the shaft suggests the same characters.

In the fragment of humerus (LACM 123995) referred to Megalodytes morejohni, the palmar position and reduced size of the deltoid crest (where preserved) and the seemingly lateral position of the capital shaft ridge are strongly suggestive of the condition observed in UCMP 93050 and LACM 122979. The only similar measurement possible on all three specimens is breadth of shaft just distal to the deltoid crest. This shows a size ratio close to that observed between the tibiotarsi referred to Megalodytes sp. and the holotype of M. morejohni. Breadth of shaft LACM 122979, 11.5 mm, UCMP 93050, 11.7 mm, M. morejohni LACM 123995, 12.8 mm.

The similarity of the deltoid crest in humerus UCMP 93050 and LACM 122979 to that of LACM 123995, as well as the similarities noted in the tibiotarsi, justifies assignment of this material to the genus Megalodytes. Considering the

small difference in size, the possibility of referral to M. morejohni should be considered.

ANSERIFORMES SPP.

REFERRED SPECIMENS. Incomplete left femur, LACM 123994, from locality LACM 4956 (quarry grid section 10); proximal end of left tibiotarsus, LACM 34530 from locality LACM 1625; incomplete left tarsometatarsus, LACM 122981 from locality LACM 3161; proximal end of ulna, UCMP 95970 from locality UCMP V6323 assigned by Miller (1961) to Branta sp.

DESCRIPTION. Femur LACM 123994 is poorly preserved, lacking complete proximal and distal ends. Although similar in overall size to the femora referred to Megalodytes morejohni, it has greater antero-posterior than lateral breadth of shaft, and the popliteal area, although less deeply depressed than in M. morejohni, is more sharply defined externally by a longer ridge. Both of these femoral characters suggest possibly even greater adaptation for diving than is seen in the femora of M. morejohni.

The proximal fragment of tibiotarsus (LACM 34530) has the medially flared distal continuation of the internal cnemial crest characteristic of the divers, possibly to an even greater distal extent relative to the size of the bone than in the holotype of Megalodytes morejohni. However, it resembles that specimen in the position of the rugosities marking the muscle attachments on the posterior side. Measurements show the specimen to be even smaller than tibiotarsus UCMP 93051 listed herein as Megalodytes sp.: breadth from fibular to cnemial crests 12.5 mm in LACM 34530, 13.5 mm in UCMP 93051.

Tarsometatarsus LACM 122981 has a long internal calcaneal ridge, even longer than in Cygnus, and notably longer than in members of the Tribe Mergini. The specimen is markedly distinguished from the tarsometatarsus of Cygnus by the abrupt narrowing of the internal side of the shaft anteriorly, immediately below

the proximal end, and the gradual diminution in breadth (while retaining its depth) towards the distal end. This abrupt narrowing of the shaft is particularly noteworthy in distinction to the proximal end of tarsometatarsus (LACM 16466) previously identified (Howard, 1966) as Presbychen abavus. Much narrower metatarsal shaft is characteristic of diving forms such as the grebes and loons.

The proximal end of ulna that Miller (1961) assigned to Branta sp., noting that it was too small to be assigned to Presbychen, is similar in size to large specimens of B. canadensis, (Linnaeus, 1758) but with both olecranon and shaft markedly straighter. The high, straight olecranon is suggestive of the condition in Melanitta, Boie, 1822 but the straight shaft more closely resembles that of Cygnus, Beck^hstein, 1803.

Were it not for the occurrence of femur LACM 123994, which clearly represents a diver distinct from M. morejohni, these specimens might well have been assigned to Megalodytes.

DISCUSSION. Only one other anseriform species has been described from the Miocene of California, Branta howardae L. Miller, 1930 (see Howard, 1983). The species is based on a single distal fragment of carpometacarpus from the Late Miocene Dove Springs ^F formation (originally named Ricardo Formation and considered to be of Lower Pliocene age), in the Mohave desert, Kern County. There is no possibility of comparison of this fragment with the Sharktooth Hill material. Miller (1961) made no reference to it in discussing the ulna he assigned to Branta sp. from the latter locality.

Three other anseriform species have been described from earlier Miocene beds of North America: Paranyroca magna A. Miller and Compton, 1939; Dendrochen robusta A. Miller, 1944; and Anas integra A. Miller, 1944. All are from the Lower Miocene of Bennett County, South Dakota. Paranyroca is known only from two tarsometatarsi, for which the authors established a new "distinctive and

primitive anseriform family," the Paranyrociidae, which they said "may have some special phylogenetic relation with the Nyrocinae." The holotype of Dendrochen robusta is a humerus which Miller placed in the Tribe Dendrocygnini. The mediad placement of the capital shaft ridge and the strong undercutting of the head by the capital groove distinguish the specimen from the humeri assigned to Megalodytes. Anas integra (placed in the subfamily Anatinae) is known from a coracoid (holotype) and ulna. Both clearly represent a small anatine duck, obviously not related to Megalodytes.

CONCLUSIONS

In studying the material discussed herein it became clear that at least two extinct Middle Miocene species of large anseriform birds are present in the Sharktooth Hill Local Fauna, namely Presbychen abavus Wetmore, 1930 and Megalodytes morejohni new genus and species. It is impossible to determine from the material available whether the smaller specimens herein identified only as Megalodytes sp. represent a separate species.

While Presbychen appears to have been a goose-like bird, Megalodytes is more like the swans, though with additional adaptations for diving. The temptation was strong to list this new genus under the Mergini. I felt, however, that the adaptations to diving observed were secondary. Or, perhaps, we may postulate that ancient swans had greater diving ability, which has gradually diminished through time.

Of the fourteen anseriform specimens now known from Sharktooth Hill, four do not readily fall within either of the above genera, and should best be classified only as Anseriformes spp.

In summary the anseriform specimens from Sharktooth Hill are evaluated as follows (number of specimens in parentheses):

Order Anseriformes

Family Anatidae

but
on page
15

~~insert~~ last # of p. 14 here

Subfamily Anserinae

Tribe Cygnini

Genus Megalodytes (7)

Tribe Anserini

Genus Presbychen (3)

Anseriformes spp. (4)

ACKNOWLEDGMENTS

My thanks go to members of the Vertebrate Paleontology staff of the Natural History Museum of Los Angeles County: Lawrence G. Barnes, Kenneth E. Campbell Jr., and J. D. Stewart, who were helpful in discussion of matters concerning association of material in the deposit, importance of certain osteological characters, and reading an earlier draft of this manuscript.

I want, also, to express my thanks to the United States National Museum for providing a cast of the holotype of Presbychen abavus, and to the University of California Museum of Paleontology for the loan of the specimen assigned by Miller to Branta sp. and specimens now assigned to Megalodytes sp. Some of the specimens were collected from the Sharktooth Hill Bonebed during field operations supported by National Science Foundation Grant No. EAR 79 16508.

I am especially grateful to Dr. Pierce Brodkorb of the University of Florida who, when I met with difficulty in finding a scientific name (not already in use) for a diving bird of large size, came up with the suggestion of Megalodytes.

The bones were prepared for photographing by Howell Thomas of the LACM Vertebrate Paleontology Laboratory, photographed by John DeLeon, LACM Photographer, and arranged for plates by Mary Butler of the LACM Exhibitions Division.

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FIGURES

Figure 1. Anserine tibiotarsi: A-C Presbychen abavus, holotype USNM 11973; A, posterior, B, internal, C, anterior views; Megalodytes morejohni LACM 123991, holotype: D, anterior, E, posterior, F, internal views; Megalodytes sp. anterior view: G distal end UCMP 93052, H proximal fragment UCMP 93051.

Figure 2. Femora referred to Megalodytes morejohni: right (LACM 123993) A, posterior, B, external, C, anterior views; left (LACM 123992) D, posterior, E, external, F, anterior views.

Figure 3. Megalodytes humeri: A-C anconal, and D-F palmar views. A, D Megalodytes morejohni LACM 123995; B, E Megalodytes sp. LACM 122979; C, F Megalodytes sp. UCMP 93050. (37 mm of incomplete shaft of 93050 not shown.)



A



B



C



D



E



F



H



G



A



B



C



D



E



F



A



B



C



D



E



F



A



B



C



D



E



F

Reviewed by Larry Barnes
4 Feb. 1988

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HH

NEW ANSERIFORM RECORDS FROM THE MIDDLE MIOCENE
OF KERN COUNTY, CALIFORNIA

By

Hildegarde Howard

Alternative title:

{ New records of ~~new~~ Middle Miocene anseriform
birds from Kern County, California. } OK HH

this avoids a "... from the ... of" phrase.

and also the syntactical problem of "from the Middle Miocene
(what? deposits, rocks, etc). of Kern County, California"

or even more dynamic and informative.

NO
14
A new ^{Middle Miocene} Swan-like anseriform bird, Megalodytes morejohni,
new genus and species, from Kern County, California

✓ ? number of anseriform bones now available from Shaliba Lake Hill ?

NEW ANSERIFORM RECORDS FROM THE MIDDLE MIOCENE
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¹Emeritus Chief Curator of Science, Natural History Museum of Los Angeles County,
Los Angeles, California 90007.

INTRODUCTION

Two large anseriform birds are ~~at~~ ^{known} presently listed in the ~~avifauna of the~~ ^{Local Fauna from} Middle Miocene Sharktooth Hill Bonebed in Kern County, California: Presbychen abavus Wetmore, 1930 and Branta sp. (Miller, 1961). The latter record is based ^{only} on a single proximal end of an ulna in the collections of the University of California, Berkeley, Museum of Paleontology (UCMP no. 95970).

The holotype of Presbychen abavus is the distal end of a right tibiotarsus in the United States National Museum (USNM no. 11973). As described by Wetmore (1930:93), the specimen is "strongly suggestive of the modern Canada Goose," and "intermediate in dimension between the largest of the Canada geese and the whistling swan." Over thirty years later, the species was again ^{recognized in the} ~~cited from~~ Sharktooth Hill ^{local Fauna} (Howard, 1966) with the ^{identification} ~~assignment~~ of a proximal end of a tarsometatarsus and, questionably, a fragmentary proximal end of a femur. Both of these specimens are in the collections of the Natural History Museum of Los Angeles County (LACM nos. 16466 and 16465).

In the early 1970's, Dr. ^{G.} Victor Morejohn of ~~the~~ ^{MA} California State University, San Jose, was studying the Sharktooth Hill anseriform material in the collections of the University of California, Berkeley, Museum of Paleontology. In a letter to me dated 25 March 1974, he indicated that he ~~found~~ ^{interpreted} the proximal end of a humerus (UCMP 93050) to be in several ways more similar to that of the fossil ^{Pleistocene} diving duck, Chendytes, ^{L. Miller, 1925} than to the geese or swans. He added that a proximal fragment of tibiotarsus on loan to him from the Natural History Museum of Los Angeles County (LACM 34530) was also suggestive of Chendytes.

Fourteen anseriform bones are now known from the Sharktooth Hill Bonebed, including the previously recorded material (Wetmore, 1930; Miller, 1961; and Howard, 1966), the bones noted by Morejohn, and an additional eight specimens ~~never~~ ^{not previously} ~~before~~ studied. Among the latter is a nearly complete tibiotarsus (LACM 123991).

close association with other bones, possibly of the same individual, near
~~the Sharktooth Hill Natural Landmark in 1982,~~
 collected in 1982 from LACM locality 4956. This specimen provides the
 opportunity to compare the distal end ^{of this bone} with the holotype of Presbychen abavus.

The comparison clearly indicates distinction, with the proximal end showing
 characters associated with the diving anseriforms. ^{Very closely associated in the same}
^{quarry were found} same locality, two femora (LACM 123992 and 123993) and a fragment of a humerus
 (LACM 123995) of a large diving anseriform, ~~were found.~~ The present paper
 provides a description of a new genus and species of anseriform based on this
 material, and a discussion of

PI The possible relationships of other Sharktooth Hill anseriform ~~specimens~~ ^{to it.}
~~this new genus is discussed.~~ ^{5+ et}

collected in 1982 from LACM locality 4956 in the
 Sharktooth Hill Natural Landmark, This specimen provides —

No change

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~~Previously published~~
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Holotype (cast) distal end of tibiotarsus, USNM 11973

Referred proximal end of tarsometatarsus, LACM 16466 (Howard, 1966)

Referred proximal end of right femur, LACM 16465 (Howard, 1966)

Branta sp. (Miller, 1961)

Proximal end of ulna, UCMP 95970

Material examined by Morejohn (unrecorded)

Proximal end of right humerus, UCMP 93050, loc. V7107³

Proximal end of left tibiotarsus, LACM 34530, loc. 1625

Additional unrecorded material

Nearly complete left tibiotarsus, LACM 123991, loc. 4956

Nearly complete left femur, LACM 123992, loc. 4956

Nearly complete right femur, LACM 123993, loc. 4956

Incomplete left femur, LACM 123994, loc. 4956

Proximal fragment of right humerus, LACM 123995, loc. 4956

Proximal end of right humerus, LACM 122979, loc. 3162

Left tarsometatarsus lacking distal end, LACM 122981, loc. 316²

Proximal and distal fragments of right tibiotarsus,

UCMP 93051 and 93052, loc. V71013

Skeletons of modern anseriforms used for comparison are in the collections of the

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in front cover

Natural History Museum of Los Angeles County.

SYSTEMATICS

ORDER ANSERIFORMES

Family Anatidae

Subfamily Anserinae

Tribe Cygnini

Megalodytes new genus~~Figure 1, D-F~~TYPE SPECIES: Megalodytes morejohni, ^{new species,}

DIAGNOSIS: ^{ne having tibiotarsus} A Large anseriform with distal extension of inner cnemial crest ~~of~~
~~tibiotarsus~~ projecting beyond medial edge of shaft and extending distally below
 level of proximal terminus of fibular crest; anterior surface of shaft very
 slightly rounded (nearly flat); ^{differing} Distinguished from ~~holotype of~~ Presbychen
 Wetmore, 1930 (^{See herein} ~~Fig. 1, A-C~~) by greater breadth than depth of condylar area and
 supratendinal bridge tilted posteriorly along its proximal border; ^{and differing} Distinguished
 from ~~holotype of~~ ^{lawi} Chendytes Miller, 1925 by ^{having} less distal extension of inner cnemial
 crest, less flattened anterior face of shaft and less flared fibular crest.

Etymology: Megalo, large; dytes, diver.

From Greek, ^h and

These three bones and the holotype were ⁸ all excavated within a few square meters. The femora are clearly of the same individual, and the other two bones are comparable in integrity, mineralization, and preservation. Because we could not objectively prove absolute association, they were given separate catalog numbers. Designation of holotype and paratypes signals the possibility they belonged to one individual.

Megalodytes morejohni n. species

Figures 1D-F; 2; 3A, and D

HOLOTYPE. Left tibiotarsus with eroded proximal surface and incomplete cnemial crests, LACM 123991; Collected by Samuel A. McLeod, 8 May 1982.

PARATYPES

REFERRED SPECIMENS. Left and right femora, nearly complete, LACM 123992

(left) and LACM 123993 (right). Proximal fragment of right humerus, LACM 123995;

LOCALITY. LACM locality 4956, section 3, Sharktooth Hill Bonebed, Kern County, California.

DIAGNOSIS. As for genus.

DESCRIPTION. Both the tibiotarsus and the femora resemble those of the genus Cygnus in stoutness of the shaft. Positions of the ligamental and flexor attachments on the posterior face of the tibiotarsus, and relatively greater breadth than depth of the distal end are suggestive of the condition in Cygnus olor (Gmelin, 1789). The anterior face of the shaft is, however, flatter and the extension of the inner cnemial crest is more flared mediad and of greater distal extent, suggesting enhanced diving ability. Measurements (in millimeters) of the holotype tibiotarsus (measurements of Presbychen abavus in parentheses): Length 151.9; breadth of distal end 18.3 (Presbychen 18.6); internal depth of distal end 16.6 (Presbychen 19.0); breadth of incomplete proximal end 16.8; breadth from cnemial crest to fibular crest 14.6.

The femora resemble this element in Cygnus in the nearly straight shaft, when viewed anteriorly, which is greater in lateral breadth than antero-posterior depth. Distally the popliteal area is deeper than in Cygnus or Branta, but less sharply defined than in Mergus. The fibular condyle extends laterad slightly proximal to the external condyle, suggestive of the condition in the diving ducks, Tribe Mergini, but less abruptly protruded. In the Mergini the shaft is more curved and is relatively greater in depth than in breadth. Compared to the

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proximal fragment of ^a femur (LACM 16465) ^{that was} previously tentatively referred ^{by} (Howard ^{now} 1966) to Presbychen, the head is less proximally projected. Measurements, ⁱⁿ ~~mm~~ ^{mm} of referred femur (LACM 123993, the more complete of the two femora referred to M. morejohni): Length from neck to distal edge of rotular groove 75.4 (same as in LACM 123992); external length 81.0; breadth of distal end 22.6; depth of trochanter 15.2; breadth/depth at middle of shaft 9.5/8.5.

The characters of the referred humerus, LACM 123995, are discussed with those of humeri UCMP 93050 and LACM 122979 under Megalodytes sp.

DISCUSSION. In ^{describing} reporting the distal end of a femur of a large diving ^{mergine} ~~kanatid~~ (LACM 125994) from the ~~the~~ Middle Miocene ~~of~~ Orange County, California ~~/Howard and Barnes~~ (1987) ^{this} a relationship to the Sharktooth Hill anseriform material was ~~postulated~~. ^{After} ~~As now studied in~~ more detail, the following ^{ed study} ~~distinctions~~ ^{differences between} of the ~~femur from~~ Orange County ~~femur~~ ^{and} from the femora of Megalodytes morejohni are ~~noted~~: greater antero-posterior than lateral breadth of shaft, more abrupt protrusion of the fibular condyle, and popliteal area more clearly defined externally as well as internally. These characters suggest ~~closer similarity of the~~ ^{that the mergine from} Orange County ~~has a~~ ^{close affinity} ~~femur~~ ^{that of Chendytes and other members of the} to the Tribe Mergini than is evidenced in the femora of Megalodytes morejohni.

Megalodytes sp.

Figures 1 ⁱⁿ G, H; ~~Figure 3~~ ⁱⁿ B, C, E, F,

^{TO agree with pg. 8} ^{SPECIMENS} REFERRED MATERIAL. Proximal shaft fragment and incomplete distal end with shaft of a right tibiotarsus UCMP 93051 (proximal) and UCMP 93052 (distal); and proximal 3/4 of right humerus (UCMP 93050), all from UCMP locality V71073; proximal fragment of right humerus (LACM 122979) from locality ^{LACM} 3162.

DISCUSSION. The distal end of the tibiotarsus (UCMP 93052) resembles that of the holotype of M. morejohni in the posteriorly tilted position of the supratendinal bridge; the proximal portion of the same specimen (UCMP 93051) suggests the same faintly rounded anterior surface of the shaft found in the

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holotype of M. morejohni. As the condylar area is incomplete both laterally and antero-posteriorly in UCMP 93052, the relative breadth to depth of the distal end cannot be obtained. In breadth at the level of the supratendinal bridge, and breadth from fibular to cnemial crests, UCMP 93052 and 93051 are approximately 9 percent narrower than the holotype of M. morejohni: breadth at level of bridge UCMP 93052, 12.3 mm (in holotype M. morejohni 14.5 mm) breadth from fibular to cnemial crests, UCMP 93051, 13.5 mm (in M. morejohni, 14.6 mm).

Humerus UCMP 93050 from the same locality as the tibiotarsal fragments has a capital shaft ridge that is less acute and more lateral in position than in Branta. Resemblance is closer to the humerus of Cygnus in the position of the crest, although it is not as prominent as in the swan. This is true, as well, of humerus LACM 122979. In both humeri, also, the head is not undercut by the capital groove. This character, as well as the presence of the capital shaft ridge, distinguishes these specimens from the humeri of the diving ducks (tribe Mergini). Suggestive of the condition in the extinct Chendytes is the abrupt palmar receding of the deltoid crest just distal to the external tuberosity, and its sharp reduction after a brief flare. This area is eroded in UCMP 93050, but the outline of the shaft suggests the same characters.

In the fragment of humerus (LACM 123995) referred to Megalodytes morejohni, the palmar position and reduced size of the deltoid crest (where preserved) and the seemingly lateral position of the capital shaft ridge are strongly suggestive of the condition observed in UCMP 93050 and LACM 122979. The only similar measurement possible on all three specimens is ^{the} breadth of shaft just distal to the deltoid crest. This shows a size ratio close to that observed between the tibiotarsi referred to Megalodytes sp. and the holotype of M. morejohni. Breadth of shaft LACM 122979, 11.5 mm, UCMP 93050, 11.7 mm, M. morejohni LACM 123995, 12.8 mm.

The similarity ^{ies of} to the deltoid crest ^{on} in humerus UCMP 93050 and LACM 122979 ^{and on} to

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that of LACM 123995, as well as the similarities noted in the tibiotarsi, justifies ^Y assignment of this material to the genus Megalodytes. Considering the small difference in size, the possibility of ^{referral} specific identity to M. morejohni should be considered. now on p. 10

REFERRED SPECIMENS

ANSERIFORMES SPS.

~~MATERIAL~~. Incomplete left femur, ^P LACM 123994 ^{from} locality ^{LACM (Quarry grid)} 4956, ^{from} section 10); proximal end of left tibiotarsus, ^{from} LACM 34530 ^{from} locality 1625; incomplete left tarsometatarsus, ^{from} LACM 122981 ^{from} locality 3161; proximal end of ulna, ^{from} UCMP 95970 ^{from} locality V6323 assigned by Miller (1961) to Branta sp.

DESCRIPTION. ^{The} Femur, LACM 123994, is poorly preserved, lacking complete proximal and distal ends. Although similar in over all size to the femora referred to Megalodytes morejohni, it has greater antero-posterior than lateral breadth of shaft, and the popliteal area, ^{at} though less deeply depressed than in M. morejohni, is more sharply defined externally by a longer ridge. Both of these characters suggest possibly ^{more enhanced diving} ~~even greater~~ adaptation ~~for diving~~ ^{do} than in the femora of M. morejohni. ?

The proximal fragment of tibiotarsus, ^{at} LACM 34530, has the medially flared distal continuation of the internal cnemial crest characteristic of the divers, possibly to an even greater distal extent relative to the size of the bone than in the holotype of Megalodytes morejohni. However, it resembles that specimen in the position of the rugosities marking the muscle attachments on the posterior side. Measurements show the specimen to be even smaller than tibiotarsus UCMP 93051 listed herein as Megalodytes sp. Breadth from fibular to cnemial crests ^{are:} 12.5 mm in LACM 34530, 13.5 mm in UCMP 93051.

Tarsometatarsus LACM 122981 has a long internal calcaneal ridge, longer even than in Cygnus, and notably longer than in members of the ^{tribe} Mergini. The specimen is markedly distinguished from the tarsometatarsus of Cygnus by the

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abrupt narrowing of the internal side of the shaft anteriorly, immediately below the proximal end, and the gradual diminution in breadth (while retaining its depth) towards the distal end. This abrupt narrowing of the shaft is particularly noteworthy in distinction to the proximal end of tarsometatarsus (LACM 16466) previously ^{identified} recorded (Howard, 1966) as Presbychen abavus. ^A Much narrower metatarsal shaft is characteristic of diving forms such as the grebes and loons.

The proximal end of ^{an} ulna that Miller (1961) assigned to Branta sp., noting that it was too small to be assigned to Presbychen, is similar in size to large specimens of B. canadensis ^(Linnaeus, 1758) but ~~with~~ ^{its} both olecranon and shaft ^{are} markedly straighter. The high, straight olecranon is suggestive of the condition in Melanitta ^{perpicillata (Linnaeus, 1758)}, but the straight shaft more closely resembles that of Cygnus.

Were it not for the occurrence of femur LACM 123994, which clearly represents a diver distinct from M. morejohni, these specimens might well have been assigned to Megalodytes.

DISCUSSION

CONCLUSIONS

In studying the material discussed herein it became clear that at least two extinct species of large anseriform birds ^{are present} occurred in the ~~Kern County area in~~ ^{Sharktooth Hill local fauna,} ¹⁹³⁰ Middle Miocene time, namely Presbychen abavus Wetmore and Megalodytes morejohni, ^{new genus and species} ^{presently} It is impossible to determine from the material available whether the smaller specimens herein ^{identified only as} assigned to Megalodytes sp. represent a separate species.

While Presbychen ^{abavus} appears to have been a goose-like bird, Megalodytes ^{is more} ^{like} the swans, though with additional adaptations for diving. The temptation was strong to list this new genus under the Mergini, ^{but} I felt, however, that the adaptations to diving observed were secondary. Or, perhaps, we may postulate that ancient swans had greater diving ability, which has gradually diminished through time.

Of the fourteen anseriform specimens now known from Sharktooth Hill, four do not readily fall within either of the above genera, and should best be classified only as Anseriformes spp.

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In summary the anseriform specimens from Sharktooth Hill are evaluated as follows (number of specimens in parentheses):

Order Anseriformes

Family Anatidae

Subfamily Anserinae

Tribe Cygnini

Genus Megalodytes (7)

Tribe Anserini

Genus Presbychen (3)

Anseriformes spp. (4)

no change

ACKNOWLEDGMENTS

My thanks go to members of the Vertebrate Paleontology staff of the Natural History Museum of Los Angeles County: Lawrence G. Barnes, Kenneth E. Campbell Jr., and J. D. Stewart, who were helpful in discussion of matters concerning association of material in the deposit, importance of certain osteological characters, and reading an earlier draft of this manuscript.

I want, also, to express my thanks to the United States National Museum for providing a cast of the holotype of Presbychen abavus, and to the University of California Museum of Paleontology for the loan of the specimen assigned by Miller to Branta sp. and specimens now assigned to Megalodytes sp.

I am especially grateful to Dr. Pierce Brodkorb of the University of Florida who, when I met with difficulty in finding a scientific name (not already in use) for a diving bird of large size, came up with the suggestion of Megalodytes.

The bones were prepared for photographing by Howell Thomas of the LACM Vertebrate Paleontology Laboratory, photographed by John DeLeon, LACM Photographer, and arranged for plates by Mary Butler of the LACM Department of Exhibitions.

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FIGURES

Anserine
 FIGURE 1. ~~A~~ Tibiotarsi, ~~A~~ Presbychen abavus, holotype; ~~A~~ posterior, ~~B~~ internal, and ~~C~~ anterior views; D-F Megalodytes morejohni, holotype: anterior, posterior, internal views; ~~G~~ Megalodytes sp. ~~posterior~~ ^{anterior} view: ~~G~~ distal end, UCMP 93052, H, proximal fragment, UCMP 93051. *LACM 123991*

paratype femora
 Figure 2. ~~Femora referred to~~ Megalodytes morejohni: ~~A~~ right, (LACM 123993), ~~A~~ posterior, ~~B~~ internal, ~~C~~ anterior views; ~~A~~ left, (LACM 123992) ~~B~~ posterior, ~~E~~ internal, and ~~F~~ external anterior views.

Megalodytes
 Figure 3. ~~Humeri~~; A-C anconal, and D-F palmar views. A, D Megalodytes morejohni, paratype, ~~A~~ anconal view, ~~D~~ palmar view, ~~B~~ anconal view, ~~E~~ palmar view. LACM 123995; ~~B~~ Megalodytes sp. LACM 122979; ~~C~~ Megalodytes sp. UCMP 93050. *(37 mm of incomplete shaft of 93050 not shown.)*

~~C~~ ~~E~~, anconal view;
~~F~~ ~~I~~, palmar view.

Some of the fossils to be described in this report were derived from outcrops of the bonebed adjacent to the Sharktooth Hill National Natural Landmark, as ~~recently~~ established by the National Park Service in 1976.

4 Feb 1988

Hildegarde:

I have gone over your anseriform paper, and have mostly marked word choices and mechanical things. I have suggested a slightly different title, and different ways to structure some the headings and captions. Also, since the various bones of Megalodytes morejohni from the 1982 quarry were probably from one individual, I have suggested making them paratypes, so they will remain curated with the holotype, and have suggested some words to explain this. I also believe that you should have some background text on the Sharktooth Hill Bonebed and Local Fauna and on the previously reported birds. So.....I have created a couple of paragraphs that you could use as the first part of the Introduction and have appended the references cited therein in the same style as in your Literature Cited. Below is a printout of this. I have added it to the end of the computer disk in the Earth Sciences Office that has your manuscript on it. You can use, edit, or reject this text as you see fit, but I hope that you can and will use it with my blessings. Two other subjects that probably should be addressed; and I can't suggest text for these. Can you elaborate on the comparison with Chendytes? How do these new records relate to any previously known Miocene anseriforms from North America. Also, please remember that when you revise your text for the next draft, all you need do is pencil in your editing on the printout and let the secretaries edit it on the word processor--that's the beauty of computers.

Larry

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to Campbell
revised letter
after comments
from Campbell
& Barner

NEW ANSERIFORM RECORDS FROM THE MIDDLE MIOCENE
OF KERN COUNTY, CALIFORNIA

By

Hildegard Howard

NEW ANSERIFORM RECORDS FROM THE MIDDLE MIOCENE
OF KERN COUNTY, CALIFORNIA

By

Hildegarde Howard¹

ABSTRACT. Previously unreported anseriform bones now available from the Middle Miocene Sharktooth Hill Bonebed reveal the presence of a large form with adaptations for diving not evidenced in the previously described Presbychen abavus Wetmore 1930. The new form is described, on the basis of four specimens, as Megalodytes morejohni new genus and species. The remaining specimens are discussed as Megalodytes sp. and Anseriformes spp. The ulna previously referred (Miller 1961) to Branta sp. is included in the latter category.

¹Emeritus Chief Curator of Science, Natural History Museum of Los Angeles County, Los Angeles, California 90007.

INTRODUCTION

Two large anseriform birds are at present listed in the avifauna of the Middle Miocene Sharktooth Hill Bonebed in Kern County, California: Presbychen abavus Wetmore 1930 and Branta sp. (Miller, 1961). The latter record is based on a single proximal end of an ulna in the collections of the University of California, Berkeley, Museum of Paleontology (UCMP no. 95970).

The holotype of Presbychen abavus is the distal end of a right tibiotarsus in the United States National Museum (USNM no. 11973). As described by Wetmore (1930:93), the specimen is "strongly suggestive of the modern Canada Goose," and "intermediate in dimension between the largest of the Canada geese and the whistling swan." Over thirty years later, the species was again cited from Sharktooth Hill (Howard, 1966) with the assignment of a proximal end of a tarsometatarsus and, questionably, a fragmentary proximal end of a femur. Both of these specimens are in the collections of the Natural History Museum of Los Angeles County (LACM nos. 16466 and 16465).

In the early 1970's, Dr. Victor Morejohn of the California State University, San Jose, was studying the Sharktooth Hill anseriform material in the collections of the University of California, Berkeley, Museum of Paleontology. In a letter to me dated 25 March 1974, he indicated that he found the proximal end of a humerus (UCMP 93050) to be in several ways more similar to that of the fossil diving duck, Chendytes, than to the geese or swans. He added that a proximal fragment of tibiotarsus on loan to him from the Natural History Museum of Los Angeles County (LACM 34530) was also suggestive of Chendytes.

Fourteen anseriform bones are now known from the Sharktooth Hill Bonebed, including the previously recorded material (Wetmore 1930, Miller 1961, and Howard 1966), the bones noted by Morejohn, and an additional eight specimens never before studied. Among the latter is a nearly complete tibiotarsus (LACM 123991)

collected in 1982 from LACM locality 4956. This specimen provides the opportunity to compare the distal end with the holotype of Presbychen abavus. The comparison clearly indicates distinction, with the proximal end showing characters associated with the diving anseriforms. In the same section of the same locality, two femora (LACM 123992 and 123993) and a fragment of a humerus (LACM 123995) of a large diving anseriform were found. The present paper provides a description of a new genus and species of anseriform based on this material.

The possible relationship of other Sharktooth Hill anseriform specimens to this new genus is discussed.

METHODS AND MATERIALS

Acronyms used for institutions are:

LACM: Natural History Museum of Los Angeles County

UCMP: University of California, Berkeley, Museum of Paleontology

USNM: National Museum of Natural History, Smithsonian Institution

Anseriform material now available from Sharktooth Hill

Recorded Material

Presbychen abavus Wetmore 1930

Holotype (cast) distal end of tibiotarsus, USNM 11973

Referred proximal end of tarsometatarsus, LACM 16466 (Howard 1966)

Referred proximal end of right femur, LACM 16465 (Howard, 1966)

Branta sp. (Miller, 1961)

Proximal end of ulna, UCMP 95970

Material examined by Morejohn (unrecorded)

Proximal end of right humerus, UCMP 93050, loc. V71013

Proximal end of left tibiotarsus, LACM 34530, loc. 1625

Additional unrecorded material

Nearly complete left tibiotarsus, LACM 123991, loc. 4956

Nearly complete left femur, LACM 123992, loc. 4956

Nearly complete right femur, LACM 123993, loc. 4956

Incomplete left femur, LACM 123994, loc. 4956

Proximal fragment of right humerus, LACM 123995, loc. 4956

Proximal end of right humerus, LACM 122979, loc. 3162

Left tarsometatarsus lacking distal end, LACM 122981, loc. 3162

Proximal and distal fragments of right tibiotarsus,

UCMP 93051 and 93052, loc. V71013

Skeletons of modern anseriforms used for comparison are in the collections of the Natural History Museum of Los Angeles County.

SYSTEMATICS

ORDER ANSERIFORMES

Family Anatidae

Subfamily Anserinae

Tribe Cygnini

Megalodytes new genus

Figure 1, D-F

TYPE SPECIES: Megalodytes morejohni, n. sp.

DIAGNOSIS: Large anseriform with distal extension of inner cnemial crest of tibiotarsus projecting beyond medial edge of shaft and extending distally below level of proximal terminus of fibular crest; anterior surface of shaft very slightly rounded (nearly flat). Distinguished from holotype of Presbychen Wetmore 1930 (Fig. 1, A-C) by greater breadth than depth of condylar area and supratendinal bridge tilted posteriorly along its proximal border. Distinguished from holotype of Chendytes Miller 1925 by less distal extension of inner cnemial crest, less flattened anterior face of shaft and less flared fibular crest.

Etymology: Megalo large; dytes diver.

Megalodytes morejohni n. sp.

Figures 1D-F; 2; 3A and D

HOLOTYPE. Left tibiotarsus with eroded proximal surface and incomplete cnemial crests, LACM 123991. Collected by Samuel McLeod, 8 May 1982.

REFERRED SPECIMENS. Left and right femora, nearly complete, LACM 123992 (left) and LACM 123993 (right). Proximal fragment of right humerus, LACM 123995.

LOCALITY. LACM locality 4956, section 3, Sharktooth Hill Bonebed, Kern County California.

DIAGNOSIS. As for genus.

DESCRIPTION. Both tibiotarsus and femora resemble those of the genus Cygnus in stoutness of shaft. Positions of the ligamental and flexor attachments on the posterior face of the tibiotarsus, and relatively greater breadth than depth of distal end are suggestive of the condition in Cygnus olor. The anterior face of the shaft is, however, flatter and the extension of the inner cnemial crest is more flared mediad and of greater distal extent, suggesting greater diving ability. Measurements (in millimeters) of holotype tibiotarsus (measurements of Presbychen abavus in parentheses): Length 151.9; breadth of distal end 18.3 (18.6); internal depth of distal end 16.6 (19.0); breadth of incomplete proximal end 16.8; breadth from cnemial crest to fibular crest 14.6.

The femora resemble this element in Cygnus in the nearly straight shaft, when viewed anteriorly, which is greater in lateral breadth than antero-posterior depth. Distally the popliteal area is deeper than in Cygnus or Branta, but less sharply defined than in Mergus. The fibular condyle extends laterad slightly proximal to the external condyle, suggestive of the condition in the diving ducks, Tribe Mergini, but less abruptly protruded. In the Mergini the shaft is more curved and is relatively greater in depth than in breadth. Compared to the proximal fragment of femur (LACM 16465) previously tentatively referred (Howard,

1966) to Presbychen, the head is less proximally projected. Measurements (in mm) of referred femur LACM 123993 (the more complete of the two femora referred to M. morejohni): Length from neck to distal edge of rotular groove 75.4 (same as in LACM 123992); external length 81.0; breadth of distal end 22.6; depth of trochanter 15.2; breadth/depth at middle of shaft 9.5/8.5.

The characters of the referred humerus, LACM 123995, are discussed with those of humeri UCMP 93050 and LACM 122979 under Megalodytes sp.

DISCUSSION. In reporting the distal end of a femur of a large diving anatid (LACM 125994) from the Middle Miocene of Orange County, California (Howard and Barnes, 1987) a relationship to the Sharktooth Hill anseriform material was postulated. As now studied in more detail, the following distinctions of the Orange County femur from the femora of Megalodytes morejohni are noted: greater antero-posterior than lateral breadth of shaft, more abrupt protrusion of the fibular condyle, and popliteal area more clearly defined externally as well as internally. These characters suggest closer similarity of the Orange County femur to the Tribe Mergini than is evidenced in the femora of Megalodytes morejohni.

Megalodytes sp.

Figure 1 - G, H; Figure 3 - B, C, E, F,

REFERRED MATERIAL. Proximal shaft fragment and incomplete distal end with shaft of a right tibiotarsus UCMP 93051 (proximal) and UCMP 93052 (distal); and proximal 3/4 of right humerus (UCMP 93050), all from UCMP locality V71013; proximal fragment of right humerus (LACM 122979) from locality 3162.

DISCUSSION. The distal end of the tibiotarsus (UCMP 93052) resembles that of the holotype of M. morejohni in the posteriorly tilted position of the supratendinal bridge; the proximal portion of the same specimen (UCMP 93051) suggests the same faintly rounded anterior surface of the shaft found in the holotype of M. morejohni. As the condylar area is incomplete both laterally and

antero-posteriorly in UCMP 93052, the relative breadth to depth of the distal end cannot be obtained. In breadth at the level of the supratendinal bridge, and breadth from fibular to cnemial crests, UCMP 93052 and 93051 are approximately 9 percent narrower than the holotype of M. morejohni: breadth at level of bridge UCMP 93052, 13.3 mm (in holotype M. morejohni, 14.5 mm) breadth from fibular to cnemial crests, UCMP 93051, 13.5 mm (in M. morejohni, 14.6 mm).

Humerus UCMP 93050 from the same locality as the tibiotarsal fragments has a capital shaft ridge that is less acute and more lateral in position than in Branta. Resemblance is closer to the humerus of Cygnus in the position of the crest, although it is not as prominent as in the swan. This is true, as well, of humerus LACM 122979. In both humeri, also, the head is not undercut by the capital groove. This character, as well as the presence of the capital shaft ridge, distinguishes these specimens from the humeri of the diving ducks (Tribe Mergini). Suggestive of the condition in the extinct Chendytes is the abrupt palmar receding of the deltoid crest just distal to the external tuberosity, and its sharp reduction after a brief flare. This area is eroded in UCMP 93050, but the outline of the shaft suggests the same characters.

In the fragment of humerus (LACM 123995) referred to Megalodytes morejohni, the palmar position and reduced size of the deltoid crest (where preserved) and the seemingly lateral position of the capital shaft ridge are strongly suggestive of the condition observed in UCMP 93050 and LACM 122979. The only similar measurement possible on all three specimens is breadth of shaft just distal to the deltoid crest. This shows a size ratio close to that observed between the tibiotarsi referred to Megalodytes sp. and the holotype of M. morejohni. Breadth of shaft LACM 122979, 11.5 mm, UCMP 93050, 11.7 mm, M. morejohni LACM 123995, 12.8 mm.

The similarity to the deltoid crest in humerus UCMP 93050 and LACM 122979 to that of LACM 123995, as well as the similarities noted in the tibiotarsi,

justifies assignment of this material to the genus Megalodytes. Considering the small difference in size, the possibility of specific identity to M. morejohni should be considered.

ANSERIFORMES SPS.

MATERIAL. Incomplete left femur (LACM 123994, locality 4956, section 10), proximal end of left tibiotarsus (LACM 34530, locality 1625), incomplete left tarsometatarsus (LACM 122981, locality 3161), proximal end of ulna (UCMP 95970, locality V6323) assigned by Miller (1961) to Branta sp.

DESCRIPTION. Femur LACM 123994 is poorly preserved, lacking complete proximal and distal ends. Although similar in over all size to the femora referred to Megalodytes morejohni, it has greater antero-posterior than lateral breadth of shaft, and the popliteal area, though less deeply depressed than in M. morejohni, is more sharply defined externally by a longer ridge. Both of these characters suggest possibly even greater adaptation for diving than in the femora of M. morejohni.

The proximal fragment of tibiotarsus (LACM 34530) has the medially flared distal continuation of the internal cnemial crest characteristic of the divers, possibly to an even greater distal extent relative to the size of the bone than in the holotype of Megalodytes morejohni. However, it resembles that specimen in the position of the rugosities marking the muscle attachments on the posterior side. Measurements show the specimen to be even smaller than tibiotarsus UCMP 93051 listed herein as Megalodytes sp. Breadth from fibular to cnemial crests 12.5 mm in LACM 34530, 13.5 mm in UCMP 93051.

Tarsometatarsus LACM 122981 has a long internal calcaneal ridge, longer even than in Cygnus, and notably longer than in members of the Tribe Mergini. The specimen is markedly distinguished from the tarsometatarsus of Cygnus by the abrupt narrowing of the internal side of the shaft anteriorly, immediately below

the proximal end, and the gradual diminution in breadth (while retaining its depth) towards the distal end. This abrupt narrowing of the shaft is particularly noteworthy in distinction to the proximal end of tarsometatarsus (LACM 16466) previously recorded (Howard, 1966) as Presbychen abavus. Much narrower metatarsal shaft is characteristic of diving forms such as the grebes and loons.

The proximal end of ulna that Miller (1961) assigned to Branta sp., noting that it was too small to be assigned to Presbychen, is similar in size to large specimens of B. canadensis, but with both olecranon and shaft markedly straighter. The high, straight olecranon is suggestive of the condition in Melanitta, but the straight shaft more closely resembles that of Cygnus.

Were it not for the occurrence of femur LACM 123994, which clearly represents a diver distinct from M. morejohni, these specimens might well have been assigned to Megalodytes.

CONCLUSIONS

In studying the material discussed herein it became clear that at least two extinct species of large anseriform birds occurred in the Kern County area in Middle Miocene time, namely Presbychen abavus Wetmore and Megalodytes morejohni n. gen. and sp. It is impossible to determine from the material available whether the smaller specimens herein assigned to Megalodytes sp. represent a separate species.

While Presbychen appears to have been a goose-like bird, Megalodytes favored the swans, though with additional adaptations for diving. The temptation was strong to list this new genus under the Mergini. I felt, however, that the adaptations to diving observed were secondary. Or, perhaps, we may postulate that ancient swans had greater diving ability, which has gradually diminished through time.

Of the fourteen anseriform specimens now known from Sharktooth Hill, four do

not readily fall within either of the above genera, and should best be classified only as Anseriformes spp.

In summary the anseriform specimens from Sharktooth Hill are evaluated as follows (number of specimens in parentheses):

Order Anseriformes

Family Anatidae

Subfamily Anserinae

Tribe Cygnini

Genus Megalodytes (7)

Tribe Anserini

Genus Presbychen (3)

Anseriformes spp. (4)

ACKNOWLEDGMENTS

My thanks go to members of the Vertebrate Paleontology staff of the Natural History Museum of Los Angeles County: Lawrence G. Barnes, Kenneth E. Campbell Jr., and J. D. Stewart, who were helpful in discussion of matters concerning association of material in the deposit, importance of certain osteological characters, and reading an earlier draft of this manuscript.

I want, also, to express my thanks to the United States National Museum for providing a cast of the holotype of Presbychen abavus, and to the University of California Museum of Paleontology for the loan of the specimen assigned by Miller to Branta sp. and specimens now assigned to Megalodytes sp.

I am especially grateful to Dr. Pierce Brodkorb of the University of Florida who, when I met with difficulty in finding a scientific name (not already in use) for a diving bird of large size, came up with the suggestion of Megalodytes.

The bones were prepared for photographing by Howell Thomas of the LACM Vertebrate Paleontology Laboratory, photographed by John DeLeon, LACM Photographer, and arranged for plates by Mary Butler of the LACM Department of Exhibitions.

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FIGURES

FIGURE 1. Tibiotarsi, A-C Presbychen abavus, holotype; posterior, internal, anterior views; D-F Megalodytes morejohni, holotype: anterior, posterior, internal views; G, H Megalodytes sp. posterior view: G distal end UCMP 93052, H proximal fragment UCMP 93051.

Figure 2. Femora referred to Megalodytes morejohni: A-C right (LACM 123993) posterior, internal, anterior views; D-F left (LACM 123992) posterior, internal, anterior views.

Figure 3. Humeri; A-C anconal, and D-F palmar views. A, D Megalodytes morejohni LACM 123995; B, E Megalodytes sp. LACM 122979; C, F Megalodytes sp. UCMP 93050. (37 mm of incomplete shaft of 93050 not shown.)



A



B



C



D



E



F



H



G



A



B



C



D



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F



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D



E



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NEW ANSERIFORM RECORDS FROM THE MIDDLE MIOCENE

OF KERN COUNTY, CALIFORNIA

By

Hildegarde Howard

NEW ANSERIFORM RECORDS FROM THE MIDDLE MIOCENE
OF KERN COUNTY, CALIFORNIA

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Hildegarde Howard¹

ABSTRACT. Previously unreported anseriform bones now available from the Middle Miocene Sharktooth Hill Bonebed reveal the presence of a large form with adaptations for diving not evidenced in the previously described Presbychen abavus Wetmore 1930. The new form is described, on the basis of four specimens, as Megalodytes morejohni new genus and species. The remaining specimens are discussed as Megalodytes sp. and Anseriformes spp. The ulna previously referred (Miller 1961) to Branta sp. is included in the latter category.

¹Emeritus Chief Curator of Science, Natural History Museum of Los Angeles County, Los Angeles California 90007.

INTRODUCTION

Two large anseriform birds are at present listed in the avifauna of the Middle Miocene Sharktooth Hill Bonebed in Kern County, California: Presbychen abavus Wetmore 1930 and Branta sp. (Miller, 1961). The latter record is based on a single proximal end of an ulna in the collections of the University of California, Berkeley, Museum of Paleontology (UCMP no. 95970).

The holotype of Presbychen abavus is the distal end of a right tibiotarsus in the United States National Museum (USNM no. 11973). As described by Wetmore (1930:93), the specimen is "strongly suggestive of the modern Canada Goose," and "intermediate in dimension between the largest of the Canada geese and the Whistling Swans." ^{sc} Over thirty years later, the species was again cited from Sharktooth Hill (Howard, 1966) with the assignment of a proximal end of a tarsometatarsus and, questionably, a fragmentary proximal end of a femur. Both of these specimens are in the collections of the Natural History Museum of Los Angeles County (LACM nos. 16466 and 16465).

In the early 1970s, Dr. Victor Morejohn of the California State University, San Jose, was studying the Sharktooth Hill anseriform material in the collections of the University of California, Berkeley, Museum of Paleontology. In a letter to me dated 25 March 1974, he indicated that he found the proximal end of a humerus (UCMP 93050) to be in several ways more similar to that of the fossil diving duck, Chendytes, than to the geese or swans. He added that a proximal fragment of tibiotarsus on loan to him from the Natural History Museum of Los Angeles County (LACM 34530) was also suggestive of Chendytes. ~~possessing characters found in diving ducks rather than in geese and swans.~~

introduction

THESE RESULTS WERE OBTAINED BY THE FOLLOWING METHODS:

1. THE FIRST METHOD WAS USED FOR THE FIRST TWO YEARS.

2. THE SECOND METHOD WAS USED FOR THE NEXT TWO YEARS.

3. THE THIRD METHOD WAS USED FOR THE NEXT TWO YEARS.

4. THE FOURTH METHOD WAS USED FOR THE NEXT TWO YEARS.

5. THE FIFTH METHOD WAS USED FOR THE NEXT TWO YEARS.

6. THE SIXTH METHOD WAS USED FOR THE NEXT TWO YEARS.

7. THE SEVENTH METHOD WAS USED FOR THE NEXT TWO YEARS.

8. THE EIGHTH METHOD WAS USED FOR THE NEXT TWO YEARS.

9. THE NINTH METHOD WAS USED FOR THE NEXT TWO YEARS.

10. THE TENTH METHOD WAS USED FOR THE NEXT TWO YEARS.

11. THE ELEVENTH METHOD WAS USED FOR THE NEXT TWO YEARS.

12. THE TWELFTH METHOD WAS USED FOR THE NEXT TWO YEARS.

13. THE THIRTEENTH METHOD WAS USED FOR THE NEXT TWO YEARS.

14. THE FOURTEENTH METHOD WAS USED FOR THE NEXT TWO YEARS.

15. THE FIFTEENTH METHOD WAS USED FOR THE NEXT TWO YEARS.

16. THE SIXTEENTH METHOD WAS USED FOR THE NEXT TWO YEARS.

17. THE SEVENTEENTH METHOD WAS USED FOR THE NEXT TWO YEARS.

18. THE EIGHTEENTH METHOD WAS USED FOR THE NEXT TWO YEARS.

19. THE NINETEENTH METHOD WAS USED FOR THE NEXT TWO YEARS.

20. THE TWENTIETH METHOD WAS USED FOR THE NEXT TWO YEARS.

21. THE TWENTY-FIRST METHOD WAS USED FOR THE NEXT TWO YEARS.

22. THE TWENTY-SECOND METHOD WAS USED FOR THE NEXT TWO YEARS.

23. THE TWENTY-THIRD METHOD WAS USED FOR THE NEXT TWO YEARS.

24. THE TWENTY-FOURTH METHOD WAS USED FOR THE NEXT TWO YEARS.

25. THE TWENTY-FIFTH METHOD WAS USED FOR THE NEXT TWO YEARS.

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Fourteen anseriform bones are now known from the Sharktooth Hill Bonebed, including the previously recorded material (Wetmore 1930, Miller 1961, and Howard 1966), the bones noted by Morejohn, and an additional eight specimens never before studied. Among the latter is a nearly complete tibiotarsus (LACM 123991) collected in 1982 from LACM locality 4956. This specimen provides the opportunity to compare the distal end with the holotype of Presbychen abavus. The comparison clearly indicates distinction, with the proximal end showing characters associated with the diving anseriforms. In the same section of the same locality, two femora (LACM 123992 and 123993) and a fragment of ^ahumerus (LACM 123995) of a large diving ^panseriform were found. The present paper provides a description of a new genus and species of anseriform based on this material. The species is named in honor of Dr. Morejohn who retired before completing his study of the Kern County material.

The possible relationship of other Sharktooth Hill anseriform
 x~ specimens ot this new genus is discussed.

METHODS AND MATERIALS

Acronyms used for institutions are:

LACM: Natural History Museum of Los Angeles County

UCMP: University of California, Berkeley, Museum of Paleontology

USNM: National Museum of Natural History, Smithsonian Institution

Anseriform material now available from Sharktooth Hill

Recorded Material

Presbychen abavus Wetmore 1930

Holotype (cast) distal end of tibiotarsus, USNM 11973

Referred proximal end of tarsometatarsus, LACM 16466 (Howard 1966)

Referred proximal end of right femur, LACM 16465 (Howard, 1966)

Branta sp. (Miller, 1961)

Proximal end of ulna, UCMP 95970

Material examined by Morejohn (unrecorded)

Proximal end of right humerus, UCMP 93050, loc. V7107³ (~~V71073~~)

Proximal end of left tibiotarsus, LACM 34530, loc. 1625

Additional unrecorded material

Nearly complete left tibiotarsus, LACM 123991, loc. 4956

Nearly complete left femur, LACM 123992, loc. 4956

Nearly complete right femur, LACM 123993, loc. 4956

Incomplete left femur, LACM 123994, loc. 4956

Proximal fragment of right humerus, LACM 123995, loc. 4956

Proximal end of right humerus, LACM 122979, loc. 3162

Left tarsometatarsus lacking distal end, LACM 122981, loc. 316²₁

Proximal and distal fragments of right tibiotarsus,

UCMP 93051 and 93052, loc. V71013

Skeletons of modern anseriforms used for comparison are in the collections of the Natural History Museum of Los Angeles County.

SYSTEMATICS

ORDER ANSERIFORMES

Family Anatidae

Subfamily Anserinae

Tribe Cygnini

Megalodytes new genus

TYPE SPECIES: Megalodytes morejohni, n. sp. Figure 1, D-F.

TYPE SPECIES: Megalodytes morejohni, n. sp.

DIAGNOSIS: Large anseriform with distal extension of inner cnemial crest of tibiotarsus projecting beyond medial edge of shaft and extending distally below level of proximal terminus of fibular crest; anterior surface of shaft very slightly rounded (nearly flat). Distinguished from holotype of Presbychen Wetmore 1930 (Fig. 1, A-C) by greater breadth than depth of condylar area and supratendinal bridge tilted posteriorly along its proximal border. Distinguished from holotype of Chendytes Miller 1925 by less distal extension of inner cnemial crest, less flattened anterior face of shaft and less flared fibular crest.

Etymology: Megalo large; dytes diver.

Megalodytes morejohni n. sp.

Figures 1D-F, 2, 3A-~~and D~~

HOLOTYPE. Left tibiotarsus with eroded proximal surface and incomplete cnemial crests, LACM 123991. Collected by Samuel McLeod, 8 May 1982.

REFERRED SPECIMENS. Left and right femora, nearly complete, LACM 123992 (left) and LACM 123993 (right). Proximal fragment of right humerus, LACM 123995.

LOCALITY. LACM locality 4956, section 3, Sharktooth Hill Bonebed, Kern County California.

DIAGNOSIS. As for genus.

DESCRIPTION. Both tibiotarsus and femora resemble those of the genus Cygnus in stoutness of shaft. Positions of the ligamental and flexor attachments on the posterior face of the tibiotarsus, and relatively greater breadth than depth of distal end are suggestive of the condition in Cygnus olor. The anterior face of the shaft is, however, flatter and the extension of the inner cnemial crest is more flared mediad and of greater distaloextent, suggesting greater diving ability. Measurements (in millimeters) of holotype tibiotarsus (measurements of Presbychen abavus in parentheses): Length 151.9; breadth of distal end 18.3 (Presbychen 18.6); internal depth of distal end 16.6 (Presbychen 19.0); breadth of incomplete proximal end 16.8; breadth from cnemial crest to fibular crest 14.6.

The femora resemble this element in Cygnus in the nearly straight shaft, when viewed anteriorly, which is greater in lateral breadth than antero-posterior depth. Distally the popliteal area is deeper than in Cygnus or Branta, but less sharply defined than in Mergus. The fibular condyle extends laterad slightly proximal to the external condyle, suggestive of the condition in the diving ducks, Tribe Mergini,

Confused
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but less abruptly protruded. In the Mergini the shaft is more curved and is relatively greater in depth than in breadth. Compared to the proximal fragment of femur (LACM 16465) previously tentatively referred (Howard, 1966) to Presbychen, the head is less proximally projected. Measurements/of referred femur LACM 123993 (the more complete of the two femora referred to M. morejohni): Length from neck to distal edge of rotular groove 75.4; external length 81.0; breadth of distal end 22.6; depth of trochanter 15.2; breadth/depth at middle of shaft 9.5/8.5.

(Same as in LACM 123992)

The characters of the referred humerus, LACM 123995, are discussed with those of humeri UCMP 93050 and LACM 122979 under Megalodytes sp.

DISCUSSION. In reporting the distal end of a femur of a large diving anatid (LACM 125994) from the Middle Miocene of Orange County, ^{California} (Howard and Barnes, 1987) a relationship ^{to} of the Sharktooth Hill anseriform material was postulated. As now studied in more detail, the following distinctions of the Orange County femur from the femora of Megalodytes morejohni are noted: greater antero-posterior than lateral breadth of shaft, more abrupt protrusion of the fibular condyle, and popliteal area more clearly defined externally as well as internally. These characters suggest closer similarity of the Orange County femur to the Tribe Mergini than is evidenced in the femora of Megalodytes morejohni.

Megalodytes sp.

Figure 1-G, H; Figure 3-B, C, E, F

✓ REFERRED MATERIAL. Proximal shaft fragment and incomplete distal end with shaft of a right tibiotarsus UCMP 93051 (proximal) and UCMP 93052 (distal), and proximal 3/4 of right humerus (UCMP 93050), all from UCMP locality V71073; proximal fragment of right humerus (LACM 122979) from LACM locality 3162.

DISCUSSION. The distal end of the tibiotarsus (UCMP 93052) resembles that of the holotype of M. morejohni in the posteriorly tilted position of the supratendinal bridge; the proximal portion of the same specimen (UCMP 93051) suggests the same faintly rounded anterior surface of the shaft found in the holotype of M. morejohni. As the condylar area is incomplete both laterally and antero-posteriorly in UCMP 93052, the relative breadth to depth of the distal end cannot be obtained. In breadth at the level of the supratendinal bridge, and breadth from fibular to cnemial crests, UCMP 93052 and 93051 are approximately 9 percent narrower than the holotype of M. morejohni: breadth at level of bridge UCMP 93052, 13.3 mm, holotype M. morejohni 14.5 mm; breadth from fibular to cnemial crests, UCMP 93051, 13.5 mm, M. morejohni 14.6 mm.

Humerus UCMP 93050 from the same locality as the tibiotarsal fragments has a capital shaft ridge that is less acute and more lateral in position than in Branta. Resemblance is closer to the humerus of Cygnus in the position of the crest, although it is not as prominent as in the swan. This is true, as well, of humerus LACM 122979. In both humeri, also, the head is not undercut by the capital groove. This character, as well as the presence of the capital shaft ridge,

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The similarity of the deltoid crest in humerus ^{UCMP} 93050 and LACM 122979 to that of LACM 123995, as well as the similarities noted in the tibiotarsi, justifies assignment of this material to the genus Megalodytes. Considering the small difference in size, the possibility of specific identity to M. morejohni should be considered.

ANSERIFORMES SPS.

MATERIAL. Incomplete left femur (LACM 123994, locality 4956, section 10), proximal end of left ~~tibiotarsus~~ (LACM 34530, locality 1625), incomplete left tarsometatarsus (LACM 122981, locality 3161²), proximal end of ulna (UCMP 95970, locality V6323) assigned by Miller (1961) to Branta sp.

DESCRIPTION. Femur LACM 123994 is poorly preserved, lacking complete proximal and distal ends. Although similar in over all size to the femora referred to Megalodytes morejohni, it has greater antero-posterior than lateral breadth of shaft, and the popliteal area, though less deeply depressed than in M. morejohni, is more sharply defined externally by a longer ridge. Both of these characters suggest possibly even greater adaptation for diving than in the femora of M. morejohni.

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Were it not for the occurrence of femur LACM 123994, which clearly represents a diver distinct from M. morejohni, these specimens might well have been assigned to Megalodytes.

CONCLUSIONS

In studying the material discussed herein it became clear that at least two extinct species of large anseriform birds occurred in the Kern County area in Middle Miocene time, namely Presbychen ^{gen. and} abavus Wetmore and Megalodytes morejohni n./sp. It is impossible to determine from the material available whether the smaller specimens herein assigned to Megalodytes ^{sp.} represent a separate species.

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In summary the anseriform specimens from Sharktooth Hill are evaluated as follows (number of specimens in parentheses):

Order Anseriformes

Family Anatidae

Subfamily Anserinae

Tribe Cygnini

Genus Megalodytes (7)

Tribe Anserini

Genus Presbychen (3)

Anseriformes spp. (4)

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FIGURES

Figure 1. Tibiotarsi. A-C Presbychen abavus, holotype: ^{posterior} anterior, internal, ^{anterior} posterior views; D-F Megalodytes morejohni, holotype: anterior, posterior, internal views; G, H Megalodytes sp. posterior view; ^G proximal fragment UCMP 93051, ^H distal end UCMP 93052.

Figure 2. Femora referred to Megalodytes morejohni: A-C right (LACM 123993) posterior, ^{internal} lateral, anterior views; D-F left (LACM 123992) ^{internal} posterior, lateral, anterior views.

Figure 3. Humeri; A-C anconal, and D-F palmar views. A, D Megalodytes morejohni LACM 123995; B, E Megalodytes sp. LACM 122959; C, F Megalodytes sp. UCMP 93050. (37 mm of incomplete shaft of 93050 not shown).

FIGURES

Figure 1. Tibiotarsi, A-C Presbychen abavus, holotype: posterior, internal, anterior views; D-F Megalodytes morejohni, holotype: anterior, posterior, internal views; G, H Megalodytes sp. posterior view; ^G distal end UCMP 93052, ^H proximal fragment UCMP 93051.

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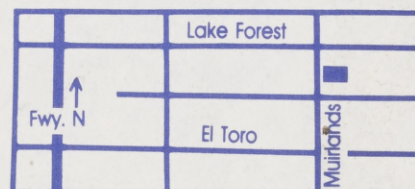
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g. br.	18.1	18.4	21.4	22.1	22.4	22.3	
depth	16.9		20.4	21.7	21.9	21.8	
depth	15.9	17.4	13.0	13.4	12.7	13.2	
incond. br		10.9					
depth							

	drill	depth	incond. br	left	shaft	drill	br
18727	16.3	16.9	11.6				
192319	16.2	16.5	9.9				
can cam	16.2	16.2					
1094	14.8	16.1	10.5	148.2	8.5	7.2	11.6
Neochers				115.5	6.4	5.0	8.4
1809	12.0	12.8	8.0				
Am. sea	13.6	13.9	9.5				
Am. platy	8.6	9.8					
219							
Mengia	9.7	9.5	6.4	86.2	5.8	3.6	7.0
1600							
Oryza	7.7	7.8	5.8				
W. ca. vol. 1267	9.2	9.2					
Melantia							
6-deg. 5'02	10.8	9.7	6.0	93.0	5.7	3.6	5.6
any	7.1	7.9					
g. br. 1635							
Fossil 123991	18.3	16.4	10.6	159.7	10.4	6.9	12.0
C. oliv 914	22.3	20.8	13.2	189.7	11.1	8.4	13.7
C. col. 1747	22.1	21.7	13.4	182.42	11.7	8.3	15.0

Frank 34530							
Chudry 1995	13.4	12.4	7.9	126.7	9.7	4.3	10.0
" 1915	13.4	12.4	8.0	136.4	9.6	5.6	9.8

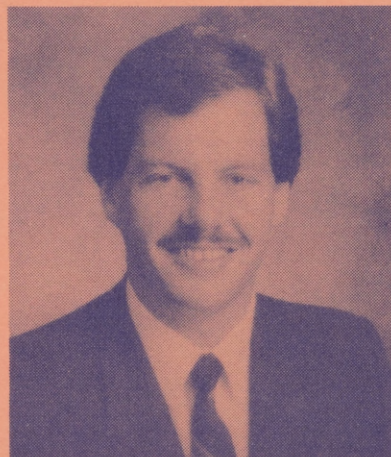
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		Length		gn br	middle shell		gn. br	depth	FEMUR	
		ext	int		sh	lth			dth	br
123	992	80.7	77.4		10.3	8.4	21.9		14.2	21.7
123	993	81.0	—		10.3	8.4	22.4		15.3	21.5
123	994	—	—		9.7	9.7	—		—	—
Oso	124994	—	—		7.6	10.2? messed	21.1		—	—
C49	col	174.7	97.0 92.3		11.5	10.2	26.1		20.2	24.8
E	olbr	91.8	97.6 91.0		11.5	9.4	24.3		18.8	24.8
B	can	109.4	88.3 82.0		8.3	9.3	22.4		19.6	24.0
M	apex	160.0	52.0 50.3		5.1	6.4	12.9		8.5	12.8
M	lantha	50.2	54.8 54.8		4.9	6.1	12.3		8.4	11.6
Ch	h. 1448	70.9	67.3		7.0	8.6	17.5		12.0	15.8

123994 from 4954 - Sq 10-D-28

others from 4954 Sq 3-D (123992)

Sq 3-H-17 (123993)

16465 not loc 1557 has more prominent head

Specimen of skeleton
at Laram (modern)

12 Cym

~~X~~ Cym col. 1747, 1774, 1439, 381, 1746

~~129797~~ ~~23~~ Cyma olz 1094, 69, 1477, 1747, 1775, 918

~~23081~~ X Branta int. 18231, 18927, 6069

10 X Branta c. cam 1094, 1074, 18231, 18722

X Branta ^{formosa} nigricans #899 and #1452

X Branta 1546 can. leaved aw #1018

X Neochama 18081

X Musca musca amon. 1514 (86787)

3 X Musca musca 1609

X Musca senata #? 6 ditent 9.1

X Anser caubereus #? 6 ditent 14.8

X ~~Anser~~ deglandi 484. melanobla nov

X Pseudocyma 688 (= 17499)

X Melia Bi 1830 (= 89947)

X Anser platystyph 219

X Taderna taderna

X Cylindrus arrenensis 86706 (Bi 9203)

X ~~Cylindrus~~ valonius 1261 (Cylindrus)

X Sarchidomus melanobla #?

X Oxymus ¹⁶⁸⁶ Bi 1553 (= 8607) (= 8601)

4 X Melanobla ^(= Oxymus) ~~melanobla~~ 522 aw 526 A

X Melanobla permutata 475 (= 86787)

X Sider 5320 Somatium

~~Taderna~~

includes 11 Cyma

Coscoroba coscoroba #10317, 123991

X Anser alba forma 1435, 725, 726
1543, 875, 1544, 1834

X Anser platystyph 21924 abm

Musca musca 1600. abm

Nepesina valonius 1261 abm

X Anser salata 1635. Cairum

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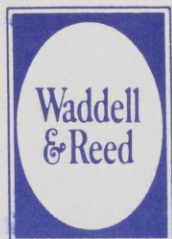
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39
 11
 50

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 2 Gidderus
 1 Nitta
 1 Anas
 1 Tadorna
 1 Aythya americana
 1 Nyroca valisineria
 1 Salsidoreus melanocephalus
 1 Eider (Gavia?)
 1 Anser yakutensis
 11

~~Approximately 50 specimens~~ ^{represent}
~~all of the subfamilies~~ ^{in the genus Anas}
~~and include 12 specimens of Cygnus, 9 of Branta~~
~~and 7 Anser~~
 and include 12 specimens of the
 genus Cygnus and 9 Branta
 approximately 50 specimens ~~12~~ of which
 represent the genus ~~Branta~~ Cygnus,
 9 Branta and 7 Anser

The 50 skeletons of modern anseriforms used for comparison
 are in the collection of the Wash. Mus. of Nat. Hist. Co.,
 and include ~~representatives of each of the following~~
~~in the 1955 Anas Gavia Gullus Chelidon~~ with
 19 genera ~~but do not~~ ^{representatives} ~~each of the following~~
~~in the 1955 Anas Gavia Gullus Chelidon~~
 and include 12 specimens of Cygnus, 9 of Branta
 8 of Anser. These 8 representatives ~~of the~~ ^{the} ~~subfamily~~
 and one more nearly the same ~~subfamily~~
 in the anseriform

NEW RECORDS OF MIDDLE MIOCENE ANSERIFORM BIRDS

FROM KERN COUNTY, CALIFORNIA

BY

HILDEGARDE HOWARD

Comments by HSC

NEW RECORDS OF MIDDLE MIOCENE ANSERIFORM BIRDS
FROM KERN COUNTY, CALIFORNIA

By

Hildegarde Howard¹

ABSTRACT. Previously unreported anseriform ^{specimens} ~~bones now available~~ from the Middle Miocene Sharktooth Hill Bonebed reveal the presence of a large species with adaptations for diving not evidenced in the previously described Presbychen abavus Wetmore, 1930. The new form is described, on the basis of four specimens, as Megalodytes morejohni new genus and species. The remaining specimens are discussed as Megalodytes sp. and Anseriformes spp. The ulna previously referred (Miller 1961) to Branta sp. is included in the latter category. Megalodytes morejohni appears to have been a swan-like anserine, while Presbychen abavus was goose-like.

¹Emeritus Chief Curator of Science, Natural History Museum of Los Angeles County, 900 Exposition Blvd., Los Angeles, California 90007.

Quoted Mitchell 1956 p iii fig. 3

INTRODUCTION

A map showing locality
would be helpful.
There must be one
available.

The Middle Miocene Sharktooth Hill Bonebed is a rich fossil deposit in the upper part of the Round Mountain Silt in Kern County, California. This bonebed is exposed near the Kern River, approximately ^{13 16 Km} 8 to 10 miles northeast of Bakersfield, and has yielded the most diverse and best studied Tertiary fossil marine vertebrate assemblage ^{should be able to get an exact figure for distance.} yet known from anywhere within the Pacific realm (Mitchell, 1966; Barnes, 1976; Barnes and Mitchell, 1984). The fossil assemblage has been named the Sharktooth Hill Local Fauna (Wood, et al., 1941), and ~~is~~ comprised of more than one hundred species of sharks, bony fish, turtles, birds and mammals, including the rare fossils of some terrestrial mammals, reptiles, and birds that originated from the adjacent Miocene land mass. Some of the fossils to be described in this report were derived from outcrops of the bonebed adjacent to the Sharktooth Hill National Natural Landmark, as established by the National Park Service in 1976.

The Sharktooth Hill Bonebed is a single, relatively thin, but laterally widespread horizon. It has been correlated with the Barstovian North American Land Mammal Age, and with the "Temblor" provisional provincial mega-invertebrate stage of Addicott (1972), and is, therefore, between approximately 13 and 15 ^{mya} million years old (Wood, et al., 1941; Mitchell, 1966; Barnes, 1976; Barnes and Mitchell, 1984:4).

^{Avian} Bones of fossils ^{those found} birds are rare in this deposit, but are in a relatively good state of preservation, even when interspersed amid larger, sometimes broken and abraded bones of mammals and other vertebrates. Fifteen avian taxa ^{were} ~~have been~~ previously reported from the Sharktooth Hill Local Fauna ^{by} Howard (1984). These include ^{d The} two large anseriform birds, Presbychen abavus Wetmore, 1930 and Branta sp. ^{to in} (Miller, 1961). The latter record is based on a single proximal end of an ulna in the collections of the Museum of Paleontology, ~~at the~~ University of

why say this about the latter and } explained in next p
nothing about the former?

California, Berkeley (UCMP ~~no~~ 95970).

The holotype of Presbychen abavus is the distal end of a right tibiotarsus in the United States National Museum (USNM ~~no~~ 11973). As described by Wetmore (1930:93), the specimen is "strongly suggestive of the modern Canada Goose," and "intermediate in dimension between the largest of the Canada geese and the whistling swan." Over thirty years later, the species was again cited from the Sharktooth Hill ~~Local~~ Fauna (Howard, 1966) with the assignment of a proximal end of a tarsometatarsus and, questionably, a fragmentary proximal end of a femur. Both of these specimens are in the collections of the Natural History Museum of Los Angeles County (LACM ~~nos~~ 16466 and 16465).

In the early 1970's, Dr. G. Victor Morejohn of the California State University, San Jose, was studying the Sharktooth Hill anseriform material in the collections of the University of California, Museum of Paleontology, ~~in~~ Berkeley. In a letter to me dated 25 March 1974, he indicated that he interpreted the proximal end of a humerus (UCMP 93050) to be in several ways more similar to that of the fossil diving duck, Chendytes, L. Miller, 1925, than to the geese or swans. He added that a proximal fragment of tibiotarsus on loan to him from the Natural History Museum of Los Angeles County (LACM 34530) was also suggestive of Chendytes.

Fourteen anseriform bones are now known from the Sharktooth Hill Bonebed, including the previously recorded material (Wetmore, 1930; Miller, 1961; ~~and~~ Howard, 1966), the bones noted by Morejohn, and an additional eight specimens not previously studied. Among the latter is a nearly complete tibiotarsus (LACM 123991) collected in 1982 from LACM locality 4956, near the Sharktooth Hill National Natural Landmark. This specimen provides the opportunity to compare the distal end with the holotype of Presbychen abavus. The comparison clearly indicates distinction, with the proximal end showing characters associated with the diving anseriforms. Very closely associated in the same quarry were two

femora (LACM 123992 and 123993) and a fragment of a humerus (LACM 123995) of a large diving anseriform. The present paper provides a description of a new genus and species based on this material. The possible relationship of other Sharktooth Hill anseriform specimens to this new genus is discussed.

Put into HP form.

METHODS AND MATERIALS

HP Acronyms used for institutions are:

- LACM; Natural History Museum of Los Angeles County;
- UCMP; University of California, Berkeley, Museum of Paleontology;
- USNM; National Museum of Natural History, Smithsonian Institution.

HP Anseriform material now available from Sharktooth Hill is as follows.

Recorded Material:

- Presbychen abavus Wetmore 1930; ^{colom H}
- Holotype (cast) distal end of tibiotarsus, USNM 11973;
- Referred proximal end of tarsometatarsus, LACM 16466 (Howard 1966);
- Referred proximal end of right femur, LACM 16465 (Howard, 1966);
- Branta sp. (Miller, 1961); ^{colom H}
- Proximal end of ulna, UCMP 95970;
- Material examined by Morejohn (unrecorded):
 - Proximal end of right humerus, UCMP 93050, loc. V71013;
 - Proximal end of left tibiotarsus, LACM 34530, loc. 1625;
- Additional unrecorded material:
 - Nearly complete left tibiotarsus, LACM 123991, loc. 4956;
 - Nearly complete left femur, LACM 123992, loc. 4956;
 - Nearly complete right femur, LACM 123993, loc. 4956;
 - Incomplete left femur, LACM 123994, loc. 4956;
 - Proximal fragment of right humerus, LACM 123995, loc. 4956;

Proximal end of right humerus, LACM 122979, loc. 3162; ↗

Left tarsometatarsus lacking distal end, LACM 122981, loc. 3162; ↗

Proximal and distal fragments of right tibiotarsus,

UCMP 93051 and 93052, loc. V71013. ⓪

Skeletons of modern anseriforms used for comparison are in the collections of the Natural History Museum of Los Angeles County, and include ?

how many of each species?

SYSTEMATICS

ORDER ANSERIFORMES *le*

Family Anatidae

Subfamily Anserinae

Tribe Cygnini

Megalodytes new genus

check ✓

authors? no
Do not need to be
included in Lit. Cit.
authors no longer
used in A.O.U. checklist
H

DIAGNOSIS: Large anserine having tibiotarsus with distal extension of inner
cnemial crest projecting beyond medial edge of shaft and extending distally ^d below *ok*
level of proximal terminus of fibular crest; anterior surface of shaft very
slightly rounded (nearly flat); distinguished from holotype of Presbychen
Wetmore, 1930 by greater breadth than depth of condylar area and supratendinal
bridge tilted posteriorly along its proximal border; and distinguished from
holotype of Chendytes ^{L.} Miller, 1925 by less distal extension of inner cnemial
crest, less flattened anterior face of shaft and less flared fibular crest.

TYPE SPECIES: Megalodytes morejohni, new species.

Etymology: From Greek Megalo, large, and dytes, diver. *le*

Megalodytes morejohni new species

Figures 1D-F; 2; 3A and D

HOLOTYPE: Left tibiotarsus with eroded proximal surface and incomplete cnemial crests, LACM 123991. Collected by Samuel A. McLeod, 8 May 1982.

REFERRED SPECIMENS. Left and right femora, nearly complete, LACM 123992, 123993;

OK (left) and LACM 123993 (right). Proximal fragment of right humerus, LACM 123995.

LOCALITY: LACM locality 4956, quarry grid section 3, Sharktooth Hill

Bonebed, Kern County, California.

← Add Horizon. ?

DIAGNOSIS: As for genus.

Etyymology:

DESCRIPTION: Both tibiotarsus and femora resemble those of the genus Cygnus — author?

in stoutness of shaft. Positions of the ligamental and flexor attachments on the posterior face of the tibiotarsus, and relatively greater breadth than depth of distal end are suggestive of the condition in Cygnus olor (Gmelin, 1789). The anterior face of the shaft is, however, flatter and the extension of the inner cnemial crest is more flared medial^{ly} and of greater distal extent, suggesting

greater diving ability. Measurements (in ^{mm} millimeters) of holotype: tibiotarsus (measurements of Presbychen abavus in parentheses): Length, 151.9; breadth of distal end, 18.3 (18.6); internal depth of distal end, 16.6 (19.0); breadth of incomplete proximal end, 16.8; breadth from cnemial crest to fibular crest, 14.6.

The femora resemble this element in Cygnus in the nearly straight shaft, when viewed anteriorly, which is greater in lateral breadth than antero-posterior depth. Distally the popliteal area is deeper than in Cygnus or Branta, but less sharply defined than in Merquus. The fibular condyle extends laterad slightly proximal to the external condyle, suggestive of the condition in the diving ducks, Tribe Mergini, but less abruptly protruded. In the Mergini the shaft is more curved and is relatively greater in depth than in breadth. Compared to the proximal fragment of a femur (LACM 16465) previously tentatively referred

not used
in ACU

(Howard, 1966) to Presbychen, the head is less proximal^{do} project^s.

Measurements (in mm) of referred femur LACM 123993 (the more complete of the two femora referred to M. morejohni): Length from neck to distal edge of rotular groove, 75.4 (same as in LACM 123992); external length, 81.0; breadth of distal end, 22.6; depth of trochanter, 15.2; breadth/depth at middle of shaft, 9.5/8.5.

The characters of the referred humerus, LACM 123995, are discussed with those of humeri UCMP 93050 and LACM 122979 under Megalodytes sp.

DISCUSSION: In reporting the distal end of a femur (LACM 125994) of a large diving anatid from the Middle Miocene of Orange County, California (Howard and Barnes, 1987), a relationship to this Sharktooth Hill anseriform material was postulated. ^{Having the specimen} ~~As now~~ studied in more detail, the following ^{characters serve to distinguish it} ~~distinctions of the~~ Orange County femur ² from ² the femora of Megalodytes morejohni are ² noted: greater antero-posterior than lateral breadth of shaft, more abrupt protrusion of the fibular condyle, and popliteal area more clearly defined externally as well as internally. These characters suggest closer affinity of the Orange County femur to the Tribe Mergini than is evidenced ^{by} ~~in~~ the femora of Megalodytes morejohni.

cf. Megalodytes sp.

Figures 1 (G, H; Figure 3 (B, C, E, F, ⁹

REFERRED SPECIMENS: Proximal shaft fragment and incomplete distal end with shaft of a right tibiotarsus UCMP 93051 (proximal) and UCMP 93052 (distal); and proximal 3/4 of right humerus (UCMP 93050), all from UCMP locality V71013; proximal fragment of right humerus (LACM 122979) from locality LACM 3162.

DISCUSSION: The distal end of the tibiotarsus (UCMP 93052) resembles that of the holotype of M. morejohni in the posteriorly tilted position of the supratendinal bridge; the proximal portion of the same specimen (UCMP 93051) suggests the same faintly rounded anterior surface of the shaft found in the holotype of M. morejohni. As the condylar area is incomplete both laterally and antero-posteriorly in UCMP 93052, the relative breadth to depth of the distal end

cannot be ^{measured} obtained. In breadth at the level of the supratendinal bridge, and breadth from fibular to cnemial crests, UCMP 93052 and 93051 are approximately 9 percent narrower than the holotype of M. morejohni: breadth at level of bridge UCMP 93052, 13.3 mm (in holotype M. morejohni, 14.5 mm); breadth from fibular to ~~cnemial~~ ^{cnemial} crests, UCMP 93051, 13.5 mm (in M. morejohni, 14.6 mm). ^{holotype?} ✓

Humerus UCMP 93050, from the same locality as the tibiotarsal fragments, has a capital shaft ridge that is less acute and more lateral in position than in Branta. Resemblance is closer to ^{the} ~~the~~ humerus of Cygnus in the position of the crest, although it is not as prominent as in the swan. This is true, as well, of humerus LACM 122979. In both humeri, also, the head is not undercut by the capital groove. This character, as well as the presence of the capital shaft ridge, distinguishes these specimens from the humeri of the diving ducks (Tribe Mergini). Suggestive of the condition in the extinct Chendytes is the abrupt palmar receding of the deltoid crest just distal to the external tuberosity, and its sharp reduction after a brief flare. This area is eroded in UCMP 93050, but the outline of the shaft suggests the same characters. ? ✓

In the fragment of humerus (LACM 123995) referred to Megalodytes morejohni, the palmar position and reduced size of the deltoid crest (where preserved) and the seemingly lateral position of the capital shaft ridge are strongly suggestive of the condition observed in UCMP 93050 and LACM 122979. The only similar measurement possible on all three specimens is breadth of shaft just distal to the deltoid crest. This shows a size ratio close to that observed between the tibiotarsi referred to Megalodytes sp. and the holotype of M. morejohni. Breadth of shaft LACM 122979, 11.5 mm; UCMP 93050, 11.7 mm; M. morejohni LACM 123995, 12.8 mm.

The similarity of the deltoid crest in humerus UCMP 93050 and LACM 122979 to that of LACM 123995, as well as the similarities noted in the tibiotarsi, justifies assignment of this material to the genus Megalodytes. Considering the

small difference in size, the possibility of referral to M. morejohni should be considered.

ANSERIFORMES spp.

REFERRED SPECIMENS: Incomplete left femur, LACM 123994, from locality LACM 4956 (quarry grid section 10); proximal end of left tibiotarsus, LACM 34530, from locality LACM 1625; incomplete left tarsometatarsus, LACM 122981, from locality LACM 3161; proximal end of ulna, UCMP 95970, from locality UCMP V6323, assigned by Miller (1961) to Branta sp.

DESCRIPTION. Femur LACM 123994 is poorly preserved, lacking complete proximal and distal ends. Although similar in overall size to the femora referred to Megalodytes morejohni, it has greater antero-posterior than lateral breadth of shaft, and the popliteal area, although less deeply depressed than in M. morejohni, is more sharply defined externally by a longer ridge. Both of these femoral characters suggest possibly even greater adaptation for diving than is seen in the femora of M. morejohni.

The proximal fragment of tibiotarsus (LACM 34530) has the medially flared distal continuation of the internal cnemial crest characteristic of the divers, possibly to an even greater distal extent relative to the size of the bone than in the holotype of Megalodytes morejohni. However, it resembles that specimen in the position of the rugosities marking the muscle attachments on the posterior side. Measurements show the specimen to be even smaller than tibiotarsus UCMP 93051, listed herein as Megalodytes sp.: breadth from fibular to cnemial crests, 12.5 mm in LACM 34530, 13.5 mm in UCMP 93051.

Tarsometatarsus LACM 122981 has a long internal calcaneal ridge, even longer than in Cygnus, and notably longer than in members of the Tribe Mergini. The specimen is markedly distinguished from the tarsometatarsus of Cygnus by the abrupt narrowing of the internal side of the shaft anteriorly, immediately below

the proximal end, and the gradual diminution in breadth (while retaining its depth) towards the distal end. This abrupt narrowing of the shaft is particularly noteworthy in distinction to the proximal end of tarsometatarsus (LACM 16466) previously identified (Howard, 1966) as Presbychen abavus. ^A Much narrower metatarsal shaft is characteristic of diving forms such as the grebes and loons. ✓

The proximal end of ulna that Miller (1961) assigned to Branta sp., noting that it was too small to be assigned to Presbychen, is similar in size to large specimens of B. canadensis, (Linnaeus, 1758), but with both olecranon and shaft markedly straighter. The high, straight olecranon is suggestive of the condition in Melanitta, Boie, 1822, but the straight shaft more closely resembles that of Cygnus, Bechstein, 1803. ^{on} ^{on}

Were it not for the occurrence of femur LACM 123994, which clearly represents a diver distinct from M. morejohni, these specimens might well have been assigned to Megalodytes.

DISCUSSION: Only one other anseriform species has been described from the Miocene of California, Branta howardae L. Miller, 1930 (see Howard, 1983). The species is based on a single distal fragment of carpometacarpus from the Late Miocene Dove Springs Formation (originally named Ricardo Formation and considered to be of Lower Pliocene age), in the Mohave desert, Kern County, ^{California}. There is no possibility of comparison of this fragment with the Sharktooth Hill material ^{carpometacarpus in the} so it is not possible to comment on the relationships of this bone with the species recognized from Miller (1961) made no reference to it in discussing the ulna he assigned to Branta sp. from the latter locality. ^{Sharktooth Hill,}

Three other anseriform species have been described from earlier Miocene beds of North America: Paranyroca magna A. Miller and Compton, 1939; Dendrochen robusta A. Miller, 1944; and Anas integra A. Miller, 1944. All are from the Lower Miocene of Bennett County, South Dakota. Paranyroca is known only from two tarsometatarsi, for which the authors established a new "distinctive and

page no. for quotes?

primitive anseriform family," the Paranyrocidæ, which they said "may have some special phylogenetic relation with the Nyrocinae." ^{CA. Miller and Compton, 1939:?} The holotype of Dendrochen robusta is a humerus ^{that} ~~which~~ Miller placed in the Tribe Dendrocygnini. The medial placement of the capital shaft ridge and the strong undercutting of the head by the capital groove distinguish the specimen from the humeri assigned to Megalodytes. Anas integra (placed in the subfamily Anatinae) is known from a coracoid (holotype) and ulna. Both ^{specimens} clearly represent a small anatine duck, obviously not related to Megalodytes.

CONCLUSIONS

In studying the material discussed herein it became clear that at least two extinct Middle Miocene species of large anseriform birds are present in the Sharktooth Hill Local Fauna, namely Presbychen abavus Wetmore, 1930 and Megalodytes morejohni new genus and species. It is impossible to determine from the material available whether the smaller specimens herein identified only as cf. Megalodytes sp. represent a separate species.

While Presbychen appears to have been a goose-like bird, Megalodytes ^{was} ~~is~~ more like the swans, though with additional adaptations for diving. The temptation was strong to list this new genus under the Mergini. I felt, however, that the adaptations ^{for} to diving observed were secondary. Or, perhaps, we may postulate that ancient swans had greater diving ability, which has gradually diminished through time.

Of the fourteen anseriform specimens now known from Sharktooth Hill, four do not readily fall within either of the above genera, and should best be classified only as Anseriformes spp.



In summary the anseriform specimens from Sharktooth Hill are evaluated as follows (number of specimens in parentheses):

Order Anseriformes

Family Anatidae

Subfamily Anserinae

Tribe Cygnini

Genus Megalodytes (7)

Tribe Anserini

Genus Presbychen (3)

Anseriformes spp. (4)

ACKNOWLEDGMENTS

My thanks go to members of the Vertebrate Paleontology staff of the Natural History Museum of Los Angeles County: Lawrence G. Barnes, Kenneth E. Campbell Jr., and J. D. Stewart, who were helpful in discussion of matters concerning association of material in the deposit, importance of certain osteological characters, and reading an earlier draft of this manuscript.

I want, also, to express my thanks to the United States National Museum for providing a cast of the holotype of Presbychen abavus, and to the University of California Museum of Paleontology for the loan of the specimen assigned by Miller to Branta sp. and specimens now assigned to Megalodytes sp. Some of the specimens were collected from the Sharktooth Hill Bonebed during field operations supported by National Science Foundation Grant No. EAR 79 16508.

I am especially grateful to Dr. ^JPierce Brodkorb of the University of Florida who, when I met with difficulty in finding a scientific name (not already in use) for a diving bird of large size, came up with the suggestion of Megalodytes.

The bones were prepared for photographing by Howell Thomas of the LACM Vertebrate Paleontology Laboratory, photographed by John DeLeon, LACM Photographer, and arranged for plates by Mary Butler of the LACM Exhibitions Division.

omit

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pl. 1. *stet*

should have been anterior ^{1st}

FIGURES

Figure 1. Anserine tibiotarsi: A-C Presbychen abayus, holotype, USNM 11973; A ^(A) in posterior, B ^(B) internal, C ^(C) anterior views; Megalodytes morejohni, LACM 123991, holotype: D ^(D) anterior, E ^(E) posterior, F ^(F) internal views; Megalodytes sp., (anterior view) G ^(G) distal end, UCMP 93052, and H ^(H) proximal fragment, UCMP 93051, in anterior view (H).

Figure 2. Femora referred to Megalodytes morejohni: right, LACM 123993, A ^(A) in posterior, B ^(B) external, C ^(C) anterior views; left, LACM 123992, D ^(D) posterior, E ^(E) external, F ^(F) anterior views.

Figure 3. Megalodytes humeri: A-C anconal, and D-F palmar views. A, D ^{cf.} Megalodytes morejohni, LACM 123995; B, E ^{cf.} Megalodytes sp., LACM 122979; C, F ^{cf.} Megalodytes sp., UCMP 93050 (37 mm of incomplete shaft of 93050 not shown.)

wrong sequence again. Anterior first. As in life.

Reviewer's Report

CONTRIBUTIONS IN SCIENCE

Natural History Museum of Los Angeles County

900 Exposition Boulevard

Los Angeles, California (213) 744-3330

SAPE

Ms. No. 04

Howard, Hildegard

Author

Title New records of middle Miocene anseriform birds from Kern
County, California

REQUIRED CHANGES *none**

SUGGESTED CHANGES *none**

OTHER COMMENTS *This may be a first. I did read the ms carefully & I neither found errors nor places where I would suggest rewording. Am I sleeping? Rather I credit the author for careful work.*

Notes from
Larry Barnes

4 Feb 1988

Hildegarde:

I have gone over your anseriform paper, and have mostly marked word choices and mechanical things. I have suggested a slightly different title, and different ways to structure some the headings and captions. Also, since the various bones of Megalodytes moreighni from the 1982 quarry were probably from one individual, I have suggested making them paratypes, so they will remain curated with the holotype, and have suggested some words to explain this. I also believe that you should have some background text on the Sharktooth Hill Bonebed and Local Fauna and on the previously reported birds. So.....I have created a couple of paragraphs that you could use as the first part of the Introduction and have appended the references cited therein in the same style as in your Literature Cited. Below is a printout of this. I have added it to the end of the computer disk in the Earth Sciences Office that has your manuscript on it. You can use, edit, or reject this text as you see fit, but I hope that you can and will use it with my blessings. Two other subjects that probably should be addressed; and I can't suggest text for these. Can you elaborate on the comparison with Chendytes? How do these new records relate to any previously known Miocene anseriforms from North America. Also, please remember that when you revise your text for the next draft, all you need do is pencil in your editing on the printout and let the secretaries edit it on the word processor--that's the beauty of computers.

INTRODUCTION

The Middle Miocene Sharktooth Hill Bonebed is a fantastically rich fossil deposit in the upper part of the Round Mountain Silt in Kern County, California. This bonebed is exposed near the Kern River, approximately 8 to 10 miles northeast of Bakersfield, and has yielded the most diverse and best studied Tertiary fossil marine vertebrate assemblage yet known from anywhere within the Pacific realm (Mitchell, 1966; Barnes, 1976; Barnes and Mitchell, 1984). The fossil assemblage has been named the Sharktooth Hill Local Fauna (Wood, et al., 1941), and is comprised of more than one hundred species of sharks, bony fish, turtles, birds and mammals, including the rare fossils of some contemporaneous terrestrial mammals, reptiles, and birds that originated from the adjacent Miocene land mass. The Sharktooth Hill Bonebed is a single, relatively thin, but laterally widespread horizon. It has been correlated with the Barstovian North American Land Mammal Age, and with the "Temblor" provisional provincial mega-invertebrate stage of Addicott (1972), and is, therefore, between approximately 13 and 15 million years old (Wood, et al., 1941; Mitchell, 1966; Barnes, 1976; Barnes and Mitchell, 1984:4).

Bones of fossil birds are rare in this deposit, but when found, they are typically in an excellent state of preservation, even when interspersed amid larger, sometimes broken and abraded bones of mammals and other vertebrates. Fifteen taxa of birds have previously been reported from the Sharktooth Hill Local Fauna (Howard, 1983, 1984), and the holotypes of all of these that are

identified to the species level were derived from the assemblage.

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A. mas.

TIBIOTARSUS

Sept 1933

new sp.	Curseriform	Chondrodes	B. can. 1094	B. can. 1094	Cygnus 69	Chondrodes 1935	Chondrodes 1935
	H. alata	123941	15231	1094	69	136	126.2
Br. dist. ant	18.4	18.3	16.2	15.0	22.4	13.5	13.8
Br. dist. post	13.5	14.0	11.6	11.3	15.5	11.5	11.8
Depth vit	19.5	16.5	16.0	16.0	18.8	13.1	12.7
Depth ext	16.9	15.4	14.0	13.9	23.3	13.0	12.6
Br. shaft body	13.8	14.3	12.3	11.4	16.7	11.1	10.0
Post Br. at top of trochanter	12.8	13.8	10.3	11.5	16.2	10.6	9.5
Dist. Depth through bud tip	8.6	8.4	6.9	7.8	11.8	7.0	6.0
Least dist. bet. condyles	11.1	9.6				8.0	7.2
X intertrochanter to top of bud	14.0	13.1	12.2	11.9	16.4	11.0	10.0
Ratio vit dist to ant							
Ratio Br. dist. ant	104.8%	91.7%	101.2%	106.6%	83.9	94.9	94.7%
Ratio Br. sh. to Br. dist	72.2%	74.5%	78.9%	76.9%	74.5%	80.4%	73.1%
Ratio X to Y							
Br. sh. middle							

Length 152. mm approx (Br. can. vit 143) (B. can. can. 149) (Cygnus 184) (Chondrodes 136 to 126.2)

Proximally the shaft is flattened anteriorly as in Chondrodes + Merquis (There is a slight rounding) also differs from Chondrodes in the length of the internal calcaneal crest, which is placed at the extreme internal edge of the shaft as in Chondrodes + Merquis, does not extend as far distally as in either of these genera.

The fibular crest Length of fibular crest 35. mm (Cygnus 34.0) B. can. vit 27.3, B. can. 35.2 Chondrodes top 29, other Chondrodes 26.4

EXT. crest appears to be distally about at the prox. extent of the fibular side (less medial than in Merquis, Perhaps equalled in Chondrodes).

123941 Distance 17.3 from prox surface to top of fibular side holotype Chondrodes 15.8; other Chondrodes 15.7 Length vit crest 27. (Chondrodes 30.5 + 27.0 to anterior surface Not to prox tip of crest, which is missing in 123941)

123941 Br./depth shaft middle 10.2/7.1 Chondrodes holotype 8.1/5.2 [other Chondrodes 7.9/4.8] Merquis am. 5.8/4.1. Perhaps can. 8.4/7.0, B. can. 8.6/7.3 Cygnus 11.2/8.8

Tibia	# 1439	21744	
By the Range in size	C. col.	173.2 - 177.4, 182.8, 184.6, 208.4, 209.5	(bird 151)
Br. shaft dist. half	C. col.	9.4 9.8 10.1 10.2 10.9 11.0	(bird 9.5)
Br. dist. end	C. col.	20.3 22.3 24.4	(bird 17.2-18.7)
Tarsus C. col. length		83.7 106.	
Br. dist. shaft from	C. col.	10.7/9.5 12.2/10.8	also to 2/9.9

ANSER, BORME FEMUR + TARSUS

Femur

(TIBIA on reverse of page)

	New anseriform sp.	12399.3	12399.4	1948 Chudys	1515 Melops	B. cancan
behind head with cond. space	12399.2					
Length	75.5	74.7		65.7	51.7	78.4
Per depth Schmid	10.2/8.5	10.2/8.4	9.5/8.0	8.7/7.2	6.8/4.8	9.3/8.0
ratio ↑	84.2%	82.3%	84.2%	88.7%	70.5%	84.2%
probable	Lag of prox end for 1567/16465 doubtful in anseriform.					

Has more prominent T upturned knob that goes into joint

Relatively slender than in the Branta genus

Area above the intercondylar space deeply excavated with marked intermuscular lines proceeding proximally on ext side almost to middle.

Chudys even more depressed distally but shaft more curved and prox end less expanded.

New sp. prox end more like Branta in expansion but with less development of ext. crest (seen on Branta, rounded off in N. sp. but still more developed than in Chudys)

Prox femur #17553 from LW 1945 loc. looks more like new sp. than ~~Branta~~ Presbychen as originally (Passerid H 1968). It lacks the development of the crest noted above.

Tarsometatarsal 122981 (humer 3162 (or 3161?)) lacks distal extremity has long interval metatarsal ridge (markedly diff than short one of Chudys). Shaft slopes in below prox end lacking the clear definition of the int side of the shaft such as occurs in Branta. Phosses is like Chudys but more marked.

Atarsus #16466 from loc. 1625 appears to have a shorter ^{int} metatarsal ridge and lacks the slope below the prox end. prox 18.3, ^{int} 14.7. Larger size compares favorably with size of Presbychen type (not) fits dist end of Presbychen type. No. 17552 prox. from LW 1945 also is probably Presbychen - does not slope off.

Humer 3162/12299, the deltoideus crest recedes below the prox end as in Chudys. The same is true of UCMF V 7103/93050 Laem Cart 56019 loc 3230

Locality 4954

✓✓ Section Sq-3-D

Apr 82

Sq-3-E-21 8 May 82

Type 11

11 17 Apr Sq-10-D-28 Apr. 82

✓ 11

Sq-3-14-17 Apr. 82

1 ⁴ fume + burner in 3-D

1 At " in 3-H

fume tube in 3-E

LOS ANGELES COUNTY MUSEUM
Vertebrate Paleontology
WITHDRAWAL CARD

Dept. No. _____ Loan No. _____

Loc. No. _____

Sc. Name _____

Material cast of type tibia

of Presbytherium abneri

Date Borrowed July 10, 1985

Borrower Hildegard Howard

Institution _____

KEG
Bones

Taromachatus $\frac{3162}{122981}$ compared with $\frac{1025}{14466}$

br/depth dental

10.1/9.7

8.9/8.4

10.3/9.9

7.8/7.6

Tibia magna magna ant. #1514 (86787)

all have
syn in sand
& flat
ant. face
but post
more angu-
lous front

Melanitta fuscescens 475 (86757)

" fusca deglandi 522 (86747)

Oxyura jamaicensis 1686 (86807)

123991 v2
Chendytes

TIBIOTARSUS from Chantrelle Hwy Locm 123991

Distinguished from Chendytes by relatively greater breadth
of distal end and shaft (relative to length).

Length in 123991 = 154.5 ; distal breadth 18.5 123990

Length in ^{holotype} Chendytes = 136.5 ; distal breadth 13.5 9.89%

90 Br. dist/length 123991 = ~~11.4%~~ 10.47%

90 Br. dist/Length Chendytes = 9.89%

Length 123991 relative = 11.120%

Br. dist/Length Chendytes = 13.5%

Br. Chendytes relative

9.8 - Br. rel. to length 6.47%

Breadth shaft 123991 =

5.47%

Breadth shaft Chendytes =

7.4

Shaft more rounded anteriorly in 123991. Chendytes very flat

Protychus
Measurements of *Protychus*
Shankhooth bird vs. other species.

(= Lham 123991)

May 1982

(3-E-21)

new gen/spec

collection
Loc 4956

length (when mended)

	be below fibula	depth same place	distal depth int.	be dist	length (when mended)
3-E-21 = 123991	crest 10.6	7.3	16.6	18.3+	151.5
		(18231) 6.7	(18231) 16.3	(18231) 16.4	(#18231) 131.0
Bramble can 1094	(#18231) 9.3				
type chondylos case	10.2	5.6	12.6	13.3?	138 mm?
chondylos 2737 1975 same mended	10.0	5.3			126.8
	8.9	4.3	12.6	13.5	126.8
Bidens drylandi 486	6.0	4.0			
		9.2			
Synops 0102 23	13.5	7.3			
Bramble c. mt. 6069	8.8				
Eider 3920	5.9	7.4			

Note: meas. was not given in holotype description of *Chondylos lawi*. My meas. are based on the illus & the cast of holotype.

Muller 1928 ~~part~~
Ender 27/145 says of *Chondylos*
Presumably his habits were those of the Surf Duck which winters along on southern Calif. shores, feeding almost in the surf & rapidly just outside the breaker line. "Closest resemblance to *Bidens perspicillata* in tarsus. Cerebral process vis a vis striae above anterior face than in *Bramble canadensis*"

Delacour "waterfowl" cont'd
Mergini - "Swim Ducks par excellence" Scaup, golden-eyes
Muscans

members of this tribe well adapted to underwater feeding
Eiders (sea ducks) are no longer included under

the mergini
annual diet under water. Spend part of life at sea &

annual ~~moor~~ is principal food (as is true also of Eiders)
Scaup good divers. Wings short. Feet large but walk with

difficulty. Nest in hollows of trees or holes in rocks or even
on ground in grass or bushes. Scaup paddle with feet (note

that Eiders use wings under water - Do the Scaups also?

Bladder Scaups "do not use their wings under water
as much as white-winged Scaups"

Harlequin - Genus Histrionicus - nest along mountain forests ^{get}
the sea surf is wintering ground. Expert swimmers & dives under water

dive in water 1 ft deep or 4 ft deep where there is gravelly bottom
use both wings & feet when plunging into the water after water. The
wings tail as a spring to make the plunge. On the gravelly bottom
the wings are closed & they walk along pushing across stones
to surface they float up like bubbles without moving wings a foot

Clamgull - long-tailed duck open seas or large lakes
Bucephala - golden-eye. winter at sea. Walk well but seldom on land

Mergus - many live along rivers good swimmers with wings
close to the body (no wing movement under water)

others at sea seldom on land except to breed.

Do not open wings under water. Dive either by leaping
or by submerging quickly.

Stiff tailed Ducks - Oxyurini short wings & heavy body.
Adapted to living & feed under water - swim slowly

P-16 Vol. 4 - Scaup & Long-tailed Ducks use wings in swimming under water
Weeder in Delacour Vol. 4

Lib. (18.6-19.3 - 96.90
19.0-19.8 - 95.9

CO 32.0

26.1 27.11
26.1 28.11

Shanktooth Hill

Measurements of Tibiotarsi of holotype Presbyche and

referred complete (nearly so) E-3-21 coel in 1982

	Ant. br.	post. br.	depth int	depth ext	br sh	depth sh	ht int
13.4 Helotyge 13.8	18.3 (18.6)	139?	19.3 (19.6)	16.7 (16.8)	13.3	9.27	10.8
14.7 E-3-21 13.0	18.2 (18.5)	13.8	16.7	—	14.5	7.8?	10.2
123941	16.0	11.5					
Branta can.							

Jan 24 '85

Comparing Locom 123991 (nearly complete tibia) with holotype dist end
 VSRM 11973 - The bridge seems less erect (more receding proxly)
 Between Chondyler (which is almost flat) T Presbyche; Internal bending shaft cont (9)
 above bridge - more rounded + trunion
 Posterior (Locom 123991) intercondyle area broader
 Anterior internal condyle has less ant-post. depth
 Proximal with ornamental cut near edge of shaft + long as in distal (Corymbus) (Merganser)
 (Chondyler) Melanitta, Locom, not as flat as tibia; Cygnus also not as flat as
 Tarsus has lower internal crest (patch)
 Merganser all have deep posterior depression, V-shaped as in distal ductus Merganser, Melanitta
 Dist end tibia distinguishes from Branta by position of "bump" on side
 of int. condyle more proximally placed in Branta, (more central in Presbyche)
 Partly int. condyle round in Branta, contour more abrupt in
 also abrupt in Cygnus (like Presbyche)
 Chondyler also has proximally placed "bump" outside ext. condyle
 But post contour abrupt as in Presbyche, Anser more abrupt than Branta
 Abruptness in Cygnus is more prox. than in Presbyche
 Somateria has "bump" lower than Branta but more ant. Also in
 all ducks the bridge tends to be more lower + more proximally tilted (form)

Jan 25 '85
 sort of shelf, More erect in Presbyche
 Tarsometatarsus 122981 or 16466. shaft part'ly slants off from into ext
 side in 122981 + is even in 16466. Dist. projection proximally more pronounced
 due to slanting in of shaft. Both have long int. crest distally, #17552 from 1975
 is most like 122981 (int side of shaft just below prox end has ridge
 medially + slopes part'ly proximally in 122981 and 17552, but shaft is straight
 in 16466 dec 1624

~~Presbychnus~~ new genus

KEEP

- ✓ Tibia tarsus 3-E21 ✓ LACM 123991 loc 4956
- ✓ Femur complete R 3-H. 17 (4956) ✓ right ✓ 123993 ^{referred}
- ✓ Femur ^m complete L Sq-3-D (4956) left ✓ 123992 ^{Paratype}
- ✓ Femur Left distal + most of shaft 10-D-28 (4956) left ✓ 123994 ^{referred}
- ✓ Rec ^{of Presbychnus 1966} 16445 prox right frag. (1557) ✓ right ✓ 16465
- ✓ Rec ^{of Presbychnus "H" 1966} 16444 prox rt = P. aborus loc 1625 16446
- ✓ Tarsometatarsus 122981 prox + most of sh. left loc. 3161 ^{Small tarsus 122981}
- Type ^{new genus} Tibia tarsus dist. & ^{most} prox with shaft Sq-~~3-D~~ 123994 (4956)
- ✓ Tibia tarsus frag. 34530 loc 1625 34530
- ✓ Humerus prox rt Sq-3-D (4956) 123995 rt?
- ✓ CAST Humerus prox rt UCM 71013/93050 LACM 50019 loc 3230
- ✓ Humerus prox rt 122979 (3162) 122979
- Species ?? ✓ Humerus dist left ^{with part of shaft} 122980 (3162) 122980
- ✓ Rec ✓ Holotype dist ^{rt} Achua USNM. Presbychnus UBAM 11973
- ✓ Prox ulna cast UCM 95972 also from original UCM 95972.
- ✓ Prox scap 1625/96783 which is it??

The tarsometatarsi show difference & backup
the data is suggesting more than one species.

13 + holotype
2 each

~~Presbychnus tarsus 3-E21~~

loc.		
3162	2	2
3230	UCM cast	
4956	ITH	5
1625 (1)		2
1557 (1)		1
3161	1	1

over
discussion of tibia +

May 22, 1986

Comparison of ribostearns of
~~Shallcock~~ new sp of diving goose with Cheudytes et al

Tibiotarsus holotype of both ~~Charbon~~ ^{Chaudhary} & Choudhary
Barabche

Shankha H103617 ♂
~~Coscoroba~~ Cymn
Coscobba alb
Cheudytes
Cast Hold, Pambro
Pantochu
Cheudytes reformed #B1 1975
13.8

<i>Gr.</i>	Breadth distal ant	18.0	22.7	22.5	22.2	13.9	18.5	16.1
							12.5	
	Internal depth distal	16.7	21.6	21.5	22.3	12.7	19.1	8.2
	depth between condyles	9.9				8.4	11.7	126.25
	Length internals	149.7				137.2		
							26.8	
	Length fibular attach,	35.2	38.1			28.5+		88/4.3

Br / depths shaft

11.5/7.1 11.6/8.1 10.1/5.7

8, 8/4, 3

Belom fiberlar atolar

ST 5

Note: Chondytes is

7/5/71
ST^u
A130 ~~also~~ like swans (color) in tendency to slightly
raised in shaft in ^{shaft in} area near fibula all ant.
Posterior just distal to proximal end more diffuse than
in Chondyle more like swan (color not olivaceous)
and divide dors. margin & midline. Though shaft is
not as shagreened posterior & prox. as in the ducts
2 young
6.4/4.7

very flat anterior

in this case where

~~Sp.~~ sp. is very slight

roundie
Sulphur Swans

My Journal

Breath/depth shaft near

8.2/7.0 11.1/8.0 6.7/6.3

6.4/7.7

± ± - found but in area above

distal end of
dipal
Bourne Academy

any ~~ST~~ spec

Internal creek in [unclear]

at extreme intervals

ratio depth to breadth

distal end

On Humerus fibular artery

do little shaft same place

depth snap ...

Inular attachment with
3rd tube

Groove lacking in ~~the~~ ^{Sh. form}

Notes relative to

check Greater debt

Ths for lesser depth

leser hat
nur fossil

Shuttle

$$\begin{array}{r} 18.0 \end{array} \begin{array}{r} .9 \\ 16.7 \\ 16.2 \\ 5.0 \end{array}$$

Apomere

$$\begin{array}{r} 22.5 \end{array} \begin{array}{r} .9 \\ 21.7 \\ 20.2 \end{array}$$

Prothorax

$$\begin{array}{r} 18.3 \end{array} \begin{array}{r} 108 \\ 19.2 \\ 18.3 \\ 900 \end{array}$$

Chinthe

Levee of ~~Shuttle~~ distinguished from Cheudyle last in ward curve of prox end in area of trochant. ~~Shuttle~~ straight ~~through~~ trochant. area Anterior side adjacent to trochant. area markedly depressed in Cheudyles and somewhat in meysor Melanitta. ~~Shuttle~~ has slightly raised ridge but no depression adjacent. ~~Shuttle~~ not markedly set off from rest of ~~Shuttle~~ (like Sharktooth) prox condyle not markedly set off from shaft (usually Branta + Olor). But ridge appears less prominent in Sharktooth than in meysor. Melanitta resembles ~~Shuttle~~ (not ~~Shuttle~~) here + swans. Depression ~~above~~ above condyles deeper than in swans + geese but less ^{deep} sharply defined than in Cheudyles.

~~Tarsometatarsus~~ ^{Shuttle 122981 loc 361} (and possibly loc 1945 B 17552) slopes off on internal side, not ~~distally~~ ^{prox} internalmost crest on proximal side long as in Branta. Whereas Cheudyles very short + particularly as in diving ducks (Melanitta. Meysor). # 16466 from Sharktooth loc 1628 has long ^{prox} crest but not as long as 122981 and ~~Shuttle~~ does not slope off as suddenly on internal side. prox br. $\frac{1625}{16466}$ 18.3 Br. skate at end 2 crest 9.4. prox br. $\frac{3162}{122981}$ 18.4 Br. skate at end 1 crest 7.8. prox br. (1945) 17552 melanite shaft not present so far distally on this race (it has a lower central raise (prox. ant.) than either of the others).

Feb 7, 85 Gr post

Type	Distal end to tarsus 19.4 (8.5)	Distance dist of top of tibia 14.0 (8.5)	depth 19.3	ht 11.2	depth 13.82	11.2	7.7	8.3	12.9
Presbychus	18.4	13.0 (8.1)	16.5	10.4	14.2	10.0	7.9	8.4	13.8
# 123991	17.7								9.2
Branta b.	11.2	8.5	11.8	6.8		7.5			6.4
B. b. m.	11.0	8.57	11.4	6.0		7.0			
B. b. m.			11.5	6.2		7.3			
B. b. m.	11.2								

Shaft in 123991 above dist end int'ly is rounded ant'ly and ext'ly
 In Presbychus type the anterior aspect of the shaft int'ly is narrow and
 does not round into the ext. side; Thus presenting a flatter ext. surface
 of the shaft with a more definite rise.

The budg is more upright in Presbychus type, it appears to
 tip posteriorly at the top in 123991 & is more slender
 Proportions: much deeper int condyle in type and relatively ~~less~~
~~about~~ though intracondylar area breadth

$\begin{array}{r} 18.1 \overline{) 1687.00} \\ \underline{1629} \\ 440 \\ \underline{362} \\ 780 \end{array}$	$\begin{array}{r} 186 \overline{) 1907} \\ \underline{156} \\ 400 \end{array}$	$\begin{array}{r} 18.1 \overline{) 152.0} \\ \underline{9} \\ 1684 \end{array}$
---	--	---

18.6.19.0.0 one condyle

Breadth / depth tibia dist

int 18.1	16.7	92%
ext 18.1	15.2	83%

Presbychus

ls / depth	
18.6	19.0
18.4	16.8

Measurement of tibia of *Crocodylus*

$\begin{array}{r} 18.1 \overline{) 1687.00} \\ \underline{1629} \\ 440 \\ \underline{362} \\ 780 \end{array}$	$\begin{array}{r} 186 \overline{) 1907} \\ \underline{156} \\ 400 \end{array}$	$\begin{array}{r} 18.1 \overline{) 152.0} \\ \underline{9} \\ 1684 \end{array}$
---	--	---

B. Can. 14.9
 B. Can. 16.0
 B. Can. 14.0
 B. Can. 16.1

The greater depth than breadth is found in B. Can. & Presbychus
 lesser depth than breadth in *Crocodylus* and *Agouti*

margin melanism
 9.3
 9.2 dist

TIBIA

ANSERIFORM TIBIOTARSUS

Anser albifrons tibiostarsi - Recent

II	Ant br ^{Dental}	int defl ^{Dental}	ext defl	Ht int condyle
1735 ✓	13.2	14.4	12.4	8.3
725 ✓	14.1	14.7	12.5	8.2
726	12.7	13.6	11.8 (mic)	8.0
1543 R	15.1	14.5	12.4	8.5
1543 L	14.4	14.5	12.3	8.3
878 ✓	13.6	13.8	12.2	8.1
1544 R	13.8	13.7	11.5	8.0
1544 L	13.8	13.8	11.5	7.9
1837	13.7	14.0	12.3	8.0
725	14.2	14.5	12.4	8.4
	12.7 - 15.1	13.6 - 14.9	11.5 - 12.4	7.9 - 8.4

mes.
Nose
attached
here

Fossil Walstye	18.3	19.0		9.9
Prebydhan USNM 11973				10.4
Fossil EB-2 LACM 123991	18.2	16.7		
Branta can.			14.0	9.0
1094	14.9	16.1	14.0	9.3
18231	16.3	16.25	14.0	9.15
18722	16.3	16.9	15.2	

The bridge is vertically placed as in ~~the Branta~~
It is more horiz. in the swans (the upper edge
receding into the canal. The "central tubercle" is
more partially placed in the swan

1739 = *Cygnus columbianus* form
Jan 12 84
Add 1 tarsus Puffins No 3162/123554
Also complete Puffins?
Add tarsus 4954/59-4-11
Looks like 98474 etc.
form No 3160

(19414)
1397
Cygnus melanocoryphus

juv

length 74.1

lat br. sh 9.5

ant-first sh 9.0

85545
Cygnus olivaceus 9.8

88.4

11.2

9.7

86532
C. color. 1747
fossil left rt

125944
89.3 $\frac{1}{2}$ 75.4 75.3

11.5 7.9 9.8 9.5

10.7 9.8 8.7 8.5

SPECIAL

HEARING

OUT OF FOCUS?

Comparison of *Fibiotarsus*⁹³⁰⁵⁰ from Berkeley (in 2 pers)
with nsp holotype *Fibiotarsus* Shatt

93050 br 13.6 } difference of .7 95.170
123991 br 14.3

As compared *Melospiza* *annularis*

1511 51.7

1509 44.9

6.8 difference

86.470

m. furca

522 524

br 10.8 10.0

= 8

Cygnus col. C. coln

1439 1744

20.3 24.4

20.3

diff (4.1)

new secretions
Joyce

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Table of measurements

Hand 1968

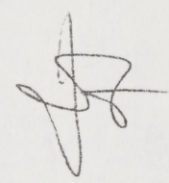
	new shaft tooth 511 122981	12000 1966 shaft tooth 16466	1945 17552 cont. meas but no tooth 16466	Cygnus col.	Breake?
Tarsometatarsus Prox br.	18.5	18.2	—	24.5	19.2?
" length int calc ridge	22.2	22.2	—	27.8	19.2
" ant br sh below/prox	8.9 10.2	10.8	?	—	—
" ant " " distally	6.6	—	no present	9.3	—
Tibiotarsus br. dist end	n. sh. 2nd tooth 123991	Presbydent type USNM 11973 18.6	19.1	2. from cy 305.0 referred?	Cygnus ole
depth dist end	18.3	19.0	19.1	13.6	20.3-24.4

Relationship close to Cygnus but with
adaptions for better diving ability.

An avianiform probably closely related to
the swans but better adapted to diving

	123992	123993	B. can can 511 122981	1747 Cygnus ed.	1094 C. ole	Chenopodium
Femur						
ext length	80.8	81.1	88.2	98.2	101.9	70.8
br. condyles excluding fibula	18.1	—	18.3	21.4	21.3	13.5
br/depth shaft	9.3/8.6	9.1/8.4	9.0/7.8	11.5/10.5	11.7/9.5	7.1/8.8
ratio br/depth	114%	108%	110%	105%	109%	80%

M E M O R A N D U M
FROM: JOHN M. HARRIS



April 27th, 1987

TO: Earth Sciences Curators

DESIGN & PRODUCTION MEETINGS SCHEDULE

As you may now be aware, there has been some confusion over the scheduling of meetings during the forthcoming visit of Design & Production Inc at which they will present their Phase 1 design concept.

The meeting now scheduled for Wednesday May 27 at 3 pm in the Auditorium -- as per Peter Keller's memo of April 23rd -- will be the only scheduled opportunity that you will have to experience D & P's presentation of their Phase 1 concept, and to discuss aspects of the concept with the design staff, before the concept is presented to the Director and Members of the Board of Trustees for approval. The working meeting between E. S. Curators and D & P staff, originally scheduled for 1.30 pm on April 23rd, and subsequently rescheduled by agreement with D & P for 1.30 pm on May 28th, has been cancelled.

The meeting in the Auditorium will be followed immediately by a meeting of the Earth Sciences Curators in my office to further discuss the concept and its ramifications. Attendance at both meetings is mandatory for E.S. Curators. Please arrange your schedule accordingly.

123493

head/less prominent then
in 16463 assigned to

Pterychon; and live along
ext. edge anterior not farther
from ext. edge

Not sure 123492

Ausejormer

Gender and age ?

$$\begin{array}{r} 35 \\ 18.5 \overline{) 6.60} \\ \underline{555} \\ 1050 \\ \underline{925} \\ 1250 \end{array}$$

$$\begin{array}{r} .38 \\ 24.5 \overline{) 9.20} \\ \underline{735} \\ 1950 \\ \underline{1715} \\ 235 \\ \underline{235} \\ 0 \end{array}$$

$$\begin{array}{r} 28 \\ 6.6 \overline{) 185} \\ \underline{132} \\ 530 \end{array}$$

$$\begin{array}{r} 9.3 \overline{) 24.5} \\ \underline{186} \\ 590 \end{array}$$

lumi distal end

Tarsus 122981 loc. 3161 — note difference with respect to previously recorded. tarsus 14466 refers to

Prishchen

to 7.8 — depth 10
Femur 123994 from type loc. but different section of femur from OSO to 7.7 depth 10? (measured) slender laterally but OSO has deeper pectinate

area

Tarsus both have the long internal calcaneal ridge

↑
ditches have short int calcaneal ridge

Gr. 18.5 prox. # 122981 ant. br. shaft below 8.9
Gr 18.2 " " 14466 referred to Prishchen

Ant. br. below 10.5

surface inwards rimmed. ^{internally} ~~narrow~~ shaft. Shaft slopes off from ant. to post. side

in 122981, the shaft is ^{reverses in on} ~~thick~~ internal side anterior and become very narrow distally (6.6 above distal end)

Calc ridge much shorter in ditches & Chetyshe hooked at distal end

length of int calc. ridge 122981 22.2

" " " " 14466 22.2

" " " " Modern Branta 19.2 (to prox 17+?)
canadensis

Reg's columba to tarsus 24.5 prox

length int calc ridge 27.8

least to sh. s 9.3 (dist.)

"Gadding About With Ethie"



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Be/delth diet tibia ^{delth} 95% d h.; br. 105% d h.

Oxyura 8.8/7.4

Aix sp. 2.5/2.8 ✓ 104% delth to br

Smatic long beak 4879 11.3/11.3 equal br/depth

Mareca m. an 9.2/9.0

redundant perulata 539 9.0/8.6

1, ragoa american 920 8.1/8.4 ✓ depth exceeds breadth

Bucconia clayton 8.0/7.9

Ardea alba 1834 13.6/14.0 ✓ delth 103% q br

Prastacan. leuca 1011 13.3/14.6 ✓ delth 109% q br.

Cygnus col. 1475 21.7/21.4 delth 98% q br (br. 101% of depth)

Cygnus olor 1096 22.7/21.5 94% delth 94% of br.: (br. 105% of depth)

18.3/16.3 89% depth 90% of breadth (br. 110% of depth) more like Swan than Stork

Gr. X Juss 123991

holotype Presbiter

17.7/19.1 ✓

depth greater than br as in Green and two ducks: Aix, Nyrus

holotype cast Chendytes

13.7/12.8

93% q

br/depth 90 107.0%

Chendytes 1975 0237

13.5/12.7

94.0%

" " 90 106.2%

94
22.7)2150
2043
1070
1008
177)191
177
1400
1493
90
183)1630
1647
36
19
146)1330
1314

Meas. Chondrypsis laevis

H
1955

Breadth prox end humerus 14.3
Breadth dist end humerus 4.8
Breadth dist end tibia 13.3-14.1

Breadth distal femur 16.3-18.2

" prox " 14.0-17.0

Length femur 65.7-76.4

Length humerus 70.0 ap

ratio br. hum / br. tibia

14.3 13.3

107.5-90

14.3 14.1

101.4 90

Proctophan prox hum 31.7

Proctophan br tibia dist 18.5

Proctophan prox 20.0

prox tarsus 18.3-18.6

July 71, 1983

Three Circled were borrowed 7, 26, 83
Bowie home

Re: Proby's Study

~~CAST of Proby's Study~~ ~~to be available~~
✓ Loc 15370 Prox end ulna ~~but not found~~ (UCMP 95970)

Loc cast # 50022

✓ Loc 15370 Prox end left femur LACM 16465 ^{NO}

✓ Loc 14250 Tibiotarsus (prox.) 34530

retd from Mongolia

✓ Loc 14250 Prox end rt tarsus 16466 ~~receded~~

✓ Loc 3161 Nearly complete tarsus
Thomson

numbered real

122981

✓ Loc 3162

Prox end humerus, rt
number

122979

Thomson

✓ Loc 3162

Dist end left humerus
number

122980

out?

Thomson

✓ Loc 3230

CAST humerus prox.

UCMP 50019

UCMP # 3050

59-3-10

✓ Loc 4956

Complete femur
Complete tibiotarsus

3-E-21

✓ Loc 4956

Complete right femur

3-A-17

✓ Loc 4956

Inc. left femur

10-D-28

NO

~~Loc 6688 Dist end ulna UCMP 88345~~

✓ Loc 6688

Dist end ulna UCMP 88345

CAST 50620 (UCMP 88345)

retd by Mongolia as Proby's

but probably = Mongolia's

✓ Loc 1625 - Prox scapula # 98783 Kirkland
when it

Elements in values

Humerus

ulna

femur

tibia

tarsus

scapula?

For comparison need The ~~above~~ elements of
Branta, Anser, Tringoidae
Oidemia, Somateria, Nyroa

also cart. type tibia Chendytes
and ~~tibia~~ ^{and} ~~femur~~ ^{tarsus} of Chendytes
sets from Blue Water (Recent?)
from San Miguel Island

	Presbychen	^{Megalodytes} Amplidytes	^{cent type} Chendytes
A Gr. B. across condyles	18.3	18.0.	(13.7) 13.5
B Depth shaft thru bridge	8.6	8.4	7.0 6.0
C Br. Shaft above condyles	12.8	13.6	10.2 9.5
RxxxxBaz			
D Gr. depth internal condyle	19.3	16.5	13.1 12.7
Ratio DA	105%	91.6%	95.6% 94.0%
RATIO BC	XXXX ø&, L 67,1%	61.7	70.0 63.1%

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Presbychen

July 7, 1983

although the dist. end of tibia is similar in Branta
and ~~Chendytes~~ Presbychen the upper end of the shaft
as now obtained ^{in new series} (12-3991) exhibit the ^{anterior} flattened
characteristics of Chendytes Mergus mergamus and
to a lesser extent in the Scotas

NW
considered
new
series
+ spec
186

3-E = 21 Depth of nit condyle 16.8 (19.4 (Branta can. 14.2)
" " " " incomplete (but lies (heavy int) B. can. 14.0 (#15231)
" " " " " ^{16.8} B. can 16.3 (Chendytes 1303-14.1)
Br. dist. end 18.2 ? (me.) ^{18.6} B. can 140.7, 93050
Length 151.6
Length Cranial ant 28.0 (int, to articula end) (10.2 in 83 can.)

122979 + cart 90000

Humerus prox end is flattened below the head anteriorly, as
in the Scotas Melanitta fusca dylandi (#499) but even more
abruptly on the ext side (suggests the condition in Chendytes ?? ^{thick})
Deltoid crest sweeps up ^{rather than straight} (suggested in Scotas)
ulnae Acnt #95970 has ^{higher, narrower olecranon than in}
Branta - suggests Melanitta (not Mergus) ~~the bone~~
appears, humerus, to be less bent than in any of the Surf Scotas
or the geese. The olecranon ~~is~~ is more erect (doesn't bend
'forward' Note: ulna of Chendytes milleri seems straighter also.
(from photo - Stu Warden ^{has the original})

Previously referred specimens of Presbychen - from Loc 1945;
#1968 Prox tarsus 17552; femur 17553; scapula 17551 (does not
and from Sharktooth Hill #1966 - Prox tarsus 16446 and ^{residual cypus in}
Specimen 16465 ^{no dorsal process}

3230
50660 Gi br. humer. Osteo. 43. mm condyle only 33.7

1922
104057 Ulna prox br. 41.5

41956
1-1 humer prox br 46.2 mic.

1847
48899 Prox tib br. inc 23.8 prox surface

1547
48800 phalange br prox 12.2

L

from Delacour "Eidulow"

Eiders separated from Mergins

The Mergins were originally referred to as Sea ducks but are now grouped under Scooters, Golden Eyes + Mergansers

"We now think that the Eiders, like the Pochards --- are an offshoot of the Anatini, or Dabbling Ducks, adapted to a special, mostly marine diving life." Eiders + Pochards have evidently evolved separately + along different lines as they show very close relationships to one another."

"I believe that the Eiders are more closely related to the Dabbling Ducks than to the Scooters, Golden-eyes + Mergansers.

Eiders method of feeding in shallow water 'tipper up' is similar to that of Dabbling Ducks. ^{young} Eiders eat plant food.

Dabbling ducks dive occasionally + use half-grown wings as means of under water propulsion. Eiders also use wings for under water propulsion

Eiders nest close to shore. - migrate. spend most of year at sea.

Eiders have large feet + heavily lobed toes - ^{and long legs} walk easily. Dive + swim well using half-grown wings to progress under water.

Nets
Pochards - genus Aythya - rare at sea

Pochards of genus Aythya are adapted to diving - large feet set back

Pochard fly well - breed on plants, nest in marshes - ^{estuarine}

Golden Scaup excellent swimmer at sea ^{quite} diving + swim under water

maxilla diving winter but also frequent ponds + rivers

Resembles Scooters in habit - prefers salt water but nest near fresh water

Mergins are an offshoot of the Cairinini (Ponding Ducks)?

Measurements of Tibiotarsus, in millimeters

	Holotype LACM 123991 n gen sp	Holotype Presbychen	Branta canadensis interior LACM 1381	1094	1094
<i>Anterior</i> Greatest length	149.4		140.4	144.0	174.7
Breadth distal end	19.0 18.4	18.6 18.3	16.6	14.8	22.2 Li 22.2 Li
Depth internal condyle	16.8 16.2 -	19.0 19.2 +	16.2 -	16.2 +	18.5 2

Syrph type Chaulioid 136.5
" 1975 " 126.6

✓ Chaulioid 1975
Li 13.4 13.3
depth 12.8 - 12.5 -
Cyanis dia 1096
Li 187.3
22.5 Br
21.5 depth -

Mergus murgensis anas
Li dist 9.8
depth 9.8
Peyh 90.4

✓ Melanitta fusca distans 475 (86757)
length 77.2
Li dist 8.9
depth dist 8.7 -

✓ Melanitta fusca distans 522 (86267)
length 98.6
Li dist 10.5
depth dist 9.9 -

140
27.3
187.3
147.5
19.9
185.4

18.4 116.20
147.2
1480
1472
80

162 1184
162
220
142
580
488
1000

over

July 31, 86

re: humeri $\frac{3162}{122979}$

and $\frac{171613}{93050}$

(cont) from 500.9 Lach
loc. 3230
Grant, Camp

and prox. tibia $\frac{1625}{34520}$

+ thin

These may represent a second ^{smaller} diving species (same genus?)
gr. depth tibia 12.5 in 34520; 14.45 in 123991 ^{authenticity murky}

depth at "neck" 10.2

12.1

11

prox to 14.27

16.1

Humeri

Br. shaft below 11.4

12.6

below crest

9.9

at middle
of crest
but not
including
crest

Depth sh. 8.8

Br. knuckle
crest when
crest bends in

13.2

15.7

Capital shaft ridge clearly on ext. side in 122979
and suggested in 123995. This suggests relationship to diving duck
Deltoid crest has a little more flare in 123995 than in
122979. Bicipital crest very wide in 123995
Gr. br. from crest to crest 34.4 in 123995 (Brach. crest 34.3, sh. 12)
32?? in the other? bicip. in complete

Humeri 123995 greatest flange of deltoid crest slightly below
greatest flange of bicip. crest - then recedes to anterior side of bone

On humeri 122979 the greatest deltoid crest flange about same

as in 123995. Arm recedes even more than in 123995

	dist to	dist depth	or depth / br.
new genus	18.3	14.6	— 90.90 or 88.20
Chondylos	13.4	12.8	— 95.90 deeper or 93.9
Prutylum	18.6	19.0	— 102.1 deeper or 104.9
Bcan int	14.8	16.2	— 109.4 deeper
Cygnus don	22.5	21.5	— 95.5 deeper
" col.	22.2	22.2	— 100.0
Bcan can.	?		
oregon	9.8	9.8	— 100
Melanostegus	8.9	8.7	— 100
Melanostegus dyscol.	10.5	9.9	— 94.2

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✓ Erect olecranon in Melanotaenia #526 June 12, 1986
 Ulna # UCM 95970 loc V 6323 (= L. cm. l. 15.57)
 We have a cast also cast # 50052 loc 1557

cf Branta can. int + C. can.
 Then Branta probably max. depth internale
 2 UCM 95970 thinner, more erect olecranon br. 14.0 depth internale 12.9
 95970 with less arcu. B.C. int 16.3 12.4
 internal side B.C. 16.2 13.0

Ulna
 assumed by
 L. mellea
 Branta sp.
 later called
 Presbytis
 by Breijohn
 (in print ?? NO)

cf Cygnus col + oler
 even more noticeably erect than in swans
 olecranon leans to int side in swans
 and prox. art. broadens also br. 23.3 C. oler 17.0
 21.7 C. col. 17.3

	Br.	depth	
Anders caeruleiceps	14.8	15.9	
Mergus sonabos	9.1	9.4	depth bet. condyle
Type like Presbytis br. distal	18.3	19.7	12.9
18231 Branta can. int	16.2		
1094 " C. can.	14.9		
1747 Cygnus col.	22.3	21.0	13.0
1775 "	21.8	21.5	14.5
1096 Cygnus oler	22.3	21.5	10.4
12399, new sp.	18.2	16.4	

Humer 4956/123995 prox. br. from bicip to deltoid crest 34.6
 34.5?

Branta can. int, 18231
 Branta large open space with less crosswork than
 in Cygnus suggest if broken would look like
 # 123995 from loc 4965. The deltoid crest however
 is even prominent in the fossil
 (hard to tell with prox. end gone)
 br. below ~~deltoid~~ bicip crest 14.5 B.C. int.

Humer 122979 L. cm. l. 3162
 br. 30.4 from bicip crest to ext. tub. Branta C. int 34.4
 br. 26.5 " bicip " to deltoid crest B.C. int 33.7

To check

Femur - Anserinae vs Anatinae

ant. edge of ext condyle elevated
from shaft in Anserinae not elevated
in Anatinae

Humerus with prominent capital shaft

ridge directed toward head in Anserinae.

This prominent capital shaft ridge ^{backing} in
Anatinae, or directed
towards ext. tuberosity.

Check Eiders vs Mergansers

Sea ducks (Gulls)

Mergus + Bucephala

Lothodytes and Mergellus

Bucephala separate from the
(Gallinula)

Romanus, Mergus + sea ducks

Chuck Eider Somateria ^{Clangula, Hystrix, Melanitta, Sitta, Oidemia}
P. 119 ^{Samolus, Polysticta}
from Melus Edward

Key to internal ridge (prox) + arsomatosis

Cercopoda Nova Hollandiae long

Bernicia magellanica long

Mergus? long?

But not Cygnus + not mergus (shorter)

Shank Femur shape - straighter than Tadoma or Fuligula

Humerus of Anas (= Dendrocygna) blanchardi ^{head} more undercut than in
Shanktooth humerus and ridge more prominent

Anas (= Dendrocygna) consobrina tibia, internal crest

less notably arched shaft than in Shanktooth 123991 or

34330 (smaller and shaft antly ^{marked} has ridge

(Shanktooth no ridge shaft almost flat (slightly rounded)

March 17, 1984

Up date on MS

for

addition Δ Shanktooth Hic

Presbycher and
? n. sp. ?

TIBIOTARSUS MEASUREMENTS ✓ CHECK ALL OF THESE

	Br. dist.	Depth dist. int	Trochcr. to fib.cr
Presbychen holotype	18.6 (Wetmore) 18.4 (cast)	19.0 (Wetmore) 19.1 (cast)	
✓ 14.4 ✓ Megalodytes holo. ✓ 183	18.2 (18.4)	✓ 16.6 16.4 (16.7) ✓	14.6
Branta c. in. 18231	16.2 (16.4)	16.7 (18.1)	
Branta c. can 1094	14.9		
Cygnus ool. 1748	24.4 (22.4)	24.9	
1774	21.8	21.0	
Cgynys okar 1096	22.6 (22.3)	21.6 (21.5) ✓	
Chendytes lawi	21.9 (12.1974)	23.0 (flange)	
Branta dickeyi	22.1 (13.8 cast holotype (13.4))	21.8 (12.8 cast holotype (12.5))	
Anser caerulescens	14.8	15.9	
Mergus serrator	9.1	9.4	

13.3 — UCMP frag 93051 *chondral to fib. crura* 13.23 ✓
 LACM loc. 1625 # 34830 *chondral to fib. crura* 12.44 ✓

	Br. cotyla	Prox. depth internally
ULNA UCMP 95970	16.0 ✓	12.9 13.5 ✓
Br. int 18231	16.3 ✓	12.5 ✓ (11.8 ± 18.722)
Branta c. can 1094	16.2 ✓	13.0 ✓
C color 1096	23.3 ✓	17.0 ✓
C. col. 1747	21.7 ✓	17.3 ✓

HUMERUS MEASUREMENTS

	Br. shaft below deltoid	Depth	Br. bicip. cr-deltoid cr.
LACM 123995	12.5	11.3	34.4
UCMP 93050	11.7	9.5	
LACM 122979	11.4	9.2	28.7?
C.col. 1439	16.6 (16.6) ✓	12.3	44.6
C. col. 1746	17.7	14.3	51.0
C. col? 381	18.0		

X Branta can?

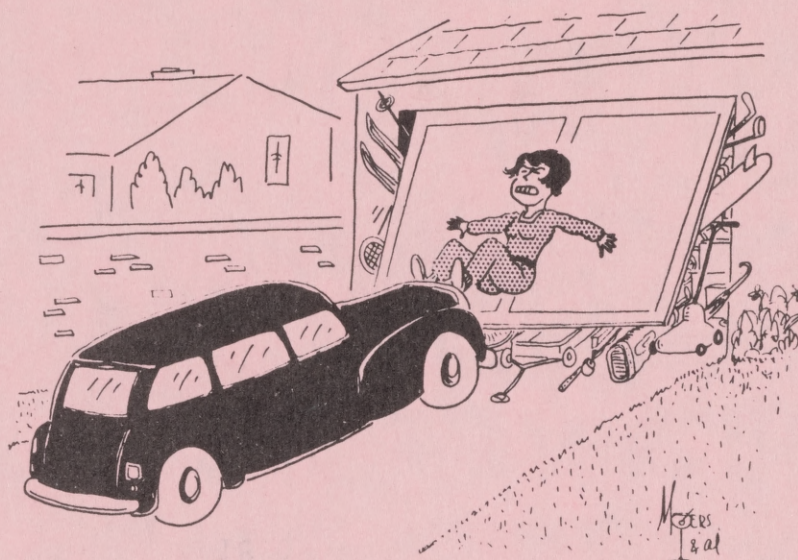
Col. 1477 20.0
 C. col. 1747 16.3
 Col 1475 16.6
 Col 1094 16.8 ✓ ulna
 Col 169 16.6 ulna

typ 14 (6) 91
 13.3 13.3
 13.4
 160

94
 13.3 12.60
 11.97
 6302
 53

144) 1330
 1296
 340

92
 14.3 1326
 1287
 330
 dir
 to
 cr
 broken



“Look Familiar?”

Who

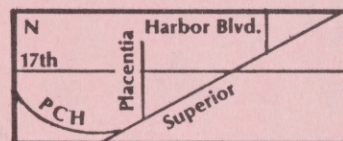
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Photos needed for n.sp. anseriform

16
9 bones
17 views

~~Eubotaurus latitarsus~~ ~~Latitarsus~~ ~~Latitarsus~~ ~~Latitarsus~~ ~~Latitarsus~~

- 1 3 (X) Tibiotarsus LACM 123991 Holotype n. sp.
Anterior done [compare USNM 11973 below]
(posterior Pjes for project done) X and 93051-52

— ✓ ^{done} to do lateral (best side) external

- 2 4 (X) Femur left ^{and} right 123992 ^{and} 123993 Paratype n. sp.
Anterior view 2 (both specimens) done
Posterior view 2 (" ") done

— ✓ ^{done} to do lateral view 2 external

- 1 1 ✓ Humeral (fragment 123995) 1 view palmar only
Palmar external view done [with humerus 122979] 2 ^{see below} ^{palmar}
anterior done 93050 2 ^{anterior}

- 1 1 (X) Left tarsometatarsus lacking distal end 122981
Anterior view done
^{Proximal end} lateral view done

- 1 2 (X) Cast of holotype of Psittychenabaurus USNM 11973
Anterior ✓ done

— ✓ ^{done} to do lateral ✓ (internal)

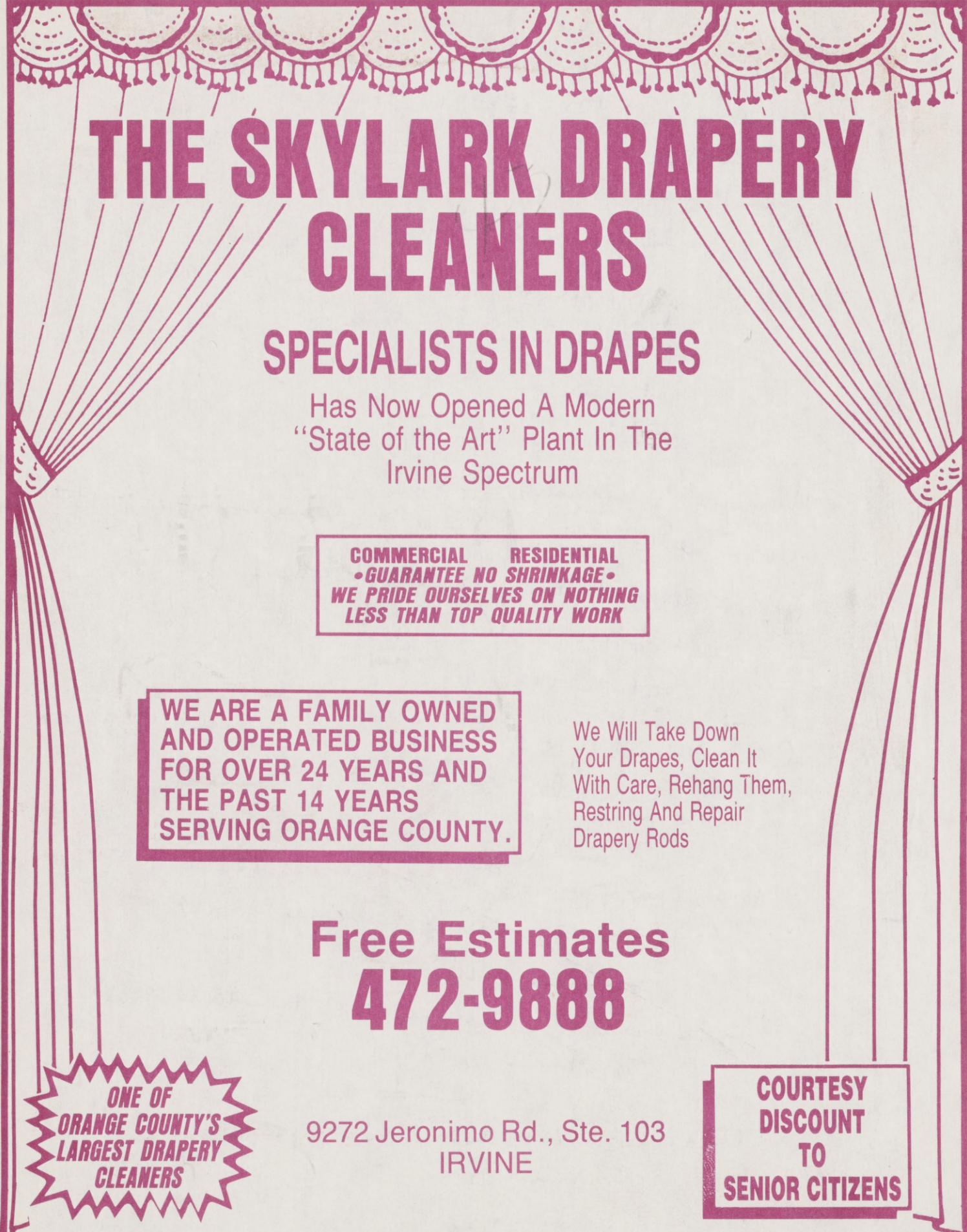
- 2 4 ✓ Proximal ends of right humeri 122979 + 93050 2
Lateral view (external) 2
palmar ^{done} and ^{anterior} views done

- 2 2 (X) Proximal and distal ends of tibiotarsus 93051-93052 Done
Together - anterior done
~~posterior~~ ~~still~~

- 1 2 Proximal left tibiotarsus 34530 (marginum exposed)
Anterior done Clean #1 of first
~~Posterior~~ ~~still~~ done

2 views

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Joyce Parkinson



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Cf. Tarsometatarsi Shauktooth & Linsen wood
 Shauktooth Hill and L.W. for 1945
 Shauktooth prox^{right} tarsus $\frac{1625}{16466}$ assigned A Prebyscheu 1H 1966
 L.W. 1945 prox left tars $\frac{1945}{17552}$ " " " " 141968
 Shauktooth prox. left tarsus $\frac{3161}{122981}$ differs from The other two

as follows: Below head on internal side slopes off noticeably
 whereas the other two have a sharp ridge extending along
 anterior face on internal side (area is rounded off in 122981)
 Internal face is rounded in 122981, flat and deep in 16466
 (This area broken away in 1945, 17552)
 The specimen from 1945 has a lower broad base where
 intercostal prominence than in either of the other two
 internal posterior ridge is long in all (? however 1945 base
 due to breakage but is supported)

Cf. Linsen wood Shauktooth & Linsen wood
 Prebyscheu $\frac{1945}{17553}$ Linsen wood has more prominent head (more
 up-turned); 16.5/8.8 depth through trochanter / ^{least} depth connection of head
 same measure in Shauktooth femora 123992: 14.8/7.7 - n. sent st
 123993 15.25/8.2 - n. sent st
 17553 more closely resembles 16465 15.4/8.4
 Prebyscheu Shauktooth proximal $\frac{1557}{16465}$ than either
 of the more complete femora from S.H. - trochanter deeper, ^{more} angular
 (anterior portion) with slight prox bend mid way (on prox border) Point
 other two S.H. have more rounded anterior femur
 Cf. Tibia Shauktooth 123991 L.W. 4956 + 34530 - 1625
 Both have nit crest at edge of shaft but 123991 much larger
 Br. across crest 123991 - 17.4; 34530 - 12.5
 " " " " - 12.7 " 10.2

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Sept 4
86

Anseriform bones from Shauhbath Hill

UCMP local, V-71013 May 1963 EL Andrus

- 93050 Right more than half of humerus with prox end
 - 93051 right frag. prox end tibia tarsus
 - 93052 right distal end tibia tarsus
- } diver
anseriform

Lacm local 4956 Sq ³ - E-21 May 1982 Sam McCleod

- ★ 123991 Holotype Tibiotarsus (left) new sp. diver anseriform (prox + dist together)
- ✓ 123992 Left femur 4956 Sq - 3-D " " " " complete
- ✓ 123993 rt femur 4956 Sq 3-H-17 new sp. diver anseriform only complete
- ✓ 123994 Left femur lacking prox end 4956 Sq 10-D-28 more slender shaft
- ✓ 123995 right prox frag. humerus 4956 Sq 3-D larger than UCMP 93050 and than 122979
- 122979 right prox end humerus 3162 called 1979) smaller than 123995 but = UCMP 93050
- UCMP 85245 shaft tarsus anseriform? loc. V 6873, pattern of prox end

- Lacm 122981 Left tarsometatarsus lacking distal condyles called 1980 loc 3161 appears slenderized - doubtful for walking, better swim.

- Lacm X 16466 ^{recorded as Presbychen} Prox right tarsometatarsus loc 1625 - could be Presbychen
- UCMP 95970 Prox ulna referred to Branta by Miller but could be Presbychen loc. V-6323 call by Mitchell 1961
- Lacm 34530 Prox left tibia loc 1625 smaller than holotype n. 123991
- Lacm X 16465 ^{recorded as Presbychen} Prox rt femur loc 1557 probably Presbychen (condyle more prominent than in 123992-93)
- UCMP X 11973 ^{Holotype Presbychen} Type dist. Tibiotarsus Presbychen above 1930

Need from UCMP Sept 4

93050, 93051, 93052 collect together in 1963

85245 (tarsus) 88411 (?)

88345 ulna now assigned to Megafalacrolophus loc V 6843

86039 tarsus now assigned to " loc V 6843

Excess for the greater distal, the popliteal area and flare of the fibular crest, 16 femur 123992 is more like the swan than diver in such; namely, short shaft heavy intermuscular line coming dist. part, force - straight shelf, cent. intermuscular line inset from ext. edge of shaft

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Unidentified

UCMP material loaned August 27, 1984 Page 1

93050 Prox humerus assigned on label to Presbychen abarus

Presbychen
to
Megadytes

But Marjolin thought it was more like the

Chaendytes wing - possibly fly flies (see letter)

Locality V71013 same as John 93051-52

I agree with Marjolin and believe it may

belong with my new species Megadytes marjolinii

93051 and 93052 distal end and prox part of shaft of

Presbychen
to
Megadytes

tibia tarsus ~~assigned~~ same locality as 93050

No comment from Marjolin. Label reads

Presbychen abarus, I believe the one

element represented by these 2 pieces can

be assigned to Megadytes Loc. V71013 same as humerus 93050

Ulna (distal half) assigned to Presbychen

abarus by Marjolin. ~~The~~ ^{Conchyl} trochlea (external)

protrudes proximally as in Phoenicepterus.

Avianiforms have rounded trochlea that merges into shaft gradually. I believe

This ulna should be assigned to Megapalaebolus

(See 86039) Locality V6843 Distal end of tarsometatarsus

labeled Presbychen abarus, matches

type of Megapalaebolus connectus Miller 1944

from Lower Miocene, slightly smaller size. Type #UCMP 37367

Prox half of shaft of tarsometatarsus

unidentified

distal shaft tibia tarsus? unidentified

Really not enough to know. (try Phoenicepterus?) But does not resemble avianiform

Seems distal end - can't find. Is this an Osteodontoornis warneri mentioned? + I returned

UCMP 88345 = LAM Cast 50620

See also cast of

cast of distal ulna

not loaned at this time from Loc. V6888

also assigned to

Presbychen but

resembles ulna of

new species

but Marjolin

86039

(Barnes 1968)

85245

Loc V68131

88411 Loc V68181

85242

V68131

X check these

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FOR PAPER ON

Fossil Anseriforms

THE ANSERIFORMES OF SHARKTOOTH HILL BONEBED, CALIFORNIA

MIDDLE MIOCENE

Anseriformes from U.S. Miocene

MIOCENE Anseriforms of U.S. (some "Pliocene")

- ✓ *Mergus miscellus* Alvarez and Olson 1978 Calvert fm. (Barstovian, Virginia)
(pelvis associated with tibiotarsi and tarsometatarsi)
- ✓ *Paranyroca magna* Miller and C mpton tarsometatarsus from Flint Hill
So. Dakota, Lower Miocene (Rosebud Fm)
- ✓ *Dendrochen robusta* complete humerus Lower Miocene So, Dakota
very overhung head
- ✓ *Presbychen abavus* Wetmore 1930 from Sharktooth Hill Mid. Miocene
distal end of tibiotarsus
- Oryzomys* *Eremochen russelli* Brodkorbi prox. humerus from Lower Pliocene (Juntura
Fm) Malheur Co Oregon. *Anserinae* 1968
- Branta esmeralda* Burt 1929 Lower Pliocene Esmeralda fm, Esmeralda Nev.
Type carpometacarpus
- ✓ *Querquedula integra* A. Miller 1944 coracoid from Low Miocene Rosebud Fm.
So Dakota (Flint Hill)
- Oxyplonessa* n. gen and sp. *shotwelli* *Martini* *referred* *carpometacarpus*
Low. Pliocene (Juntura Fm Oregon (Malheur CO.) 1961
- Bucephala ossivallis* Brodkorb 1955 Low. Pliocene Florida (Polk Co.
upper end coracoid
- ✓ *Branta* sp. (Miller recorded) from Sharktooth Hill (1961 (Condor) *ulna*
- ✓ *Presbychen abavus* recorded from LACM loc. 1945 by Howard 1968
prox. tarsometatarsus, prox. femur and prox. scapula Doubtful assign.
- NO Anseriformes from San Mateo (Late Miocene)
- NO Anseriformes from Laguna Niguel area

~~XXXXX Anseriformes~~

one femur alone dated anseriform from CSO Dam locality

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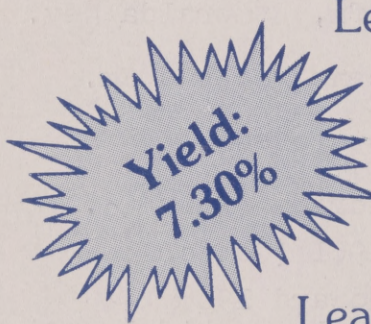
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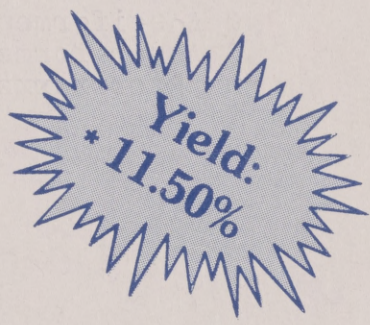


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Recorded Branta sp. recorded Muhl 1961
from prop. where

Not a goose. Belongs either with includes MEAS

Sharktooth Hill Bonebed

ANSERIFORMES

Presbychen abavus Wetmore 1930

Holotype distal end of right tibiotarsus USNM 11973
Breadth across condyles 18.6; width of external condyle 16.8 mm.
width of internal condyle 19.0. ("width" apparently means
antero-posterior diameter). CAST??? *Figures from Wetmore*

Hypotype (Howard 1966) Proximal end of tarsometatarsus nol. LACM 16466
from locality 1625. proximal breadth 18.3 mm.

Proximal end badly preserved femur no. 16465 loc. 1557 (Howard 1966)
approx. breadth proximal end 20.0 mm, ext. depth prox. 14.8 approx.

Fairly complete tarsometatarsus, unnumbered (Thomas) Loc. 3161
Prox. breadth 18.6, least breadth shaft 6.8 (near distal end) dist. end many

Complete tibiotarsus unnumbered from loc. 4956 (3-E-21) LACM 123991
Length 151.5, breadth distal end 18.5.

Nearly complete right femur loc. 4956 (3-H-17) LACM 123993
Length (ext.) 81.2, prox. breadth 20.5.

Incomplete left femur loc. 4956 (10-D-28) no measurements LACM 123992

Proximal end tibiotarsus no. 34530, loc. 1625 MORE JOHN HAS

Proximal end of scapula nol 98783, loc. 1625 (ANSERINE?)
Kirkland (where is the specimen -- check my drawer) not here

Distal end of left humerus (Howell Thomas) loc. 3162. Ident.? *very prominent
subepicondylar
area more prominent
than in diving ducks.*

Proximal end right humerus (Howell Thomas) loc. 3162 Ident.?
Greatest breadth 31.7 (inc.) *Has reduced deltoideus crest and ulna face of shaft
beaks marked on ext. side*

Proximal end of humerus CAST of UCMP 50019 loc. V71013
(= LACM loc. 3230 no. 93050) NOT MEASURED

Proximal end of left ulna CAST UCMP no. 95970 lo. V6323 *referred to Branta sp. by Muhl 1961*
(= LACM 50022, loc. 1557) Prox. breadth 15.8 mm.
Prox. depth, internally 13.5 mm.

Distal end of ulna CAST UCMP 88345 loc. 6843 (= LACM loc. 6688 no. 50620)
Breadth of trochleae 11.6 mm, depth of external trochlea 14.6 mm

nearly complete left femur 4956 - Sq-3D
NOT ANSERIFORM

Presbychen holotype sent A. C. Compton
intermediate in dimensions between the largest of the Canada geese and the White-winged Swan
Check tarsometatarsi with holotype of Paranyroca magna A. Miller /1939
well illustrated in 3 views (see reprint) (from Miocene So. Dakota)
Same locality from which he described Megapaloelodus connectens
which has been identified from Sharktooth Hill also.
Alden notes in describing Paranyroca magna that it shows affinity
to the Screamers in the configuration of the hypotarsus, but
otherwise resembles Anseriforms. He mentions Chendytes resembling
the Nyrocinae see p.154

Additional material of Presbychen shows affinity to Nyrocinae! *new genus*

Check Presbychen referred

Re-check Presbychen abavus referred specimens from loc. LACM 1945 (Howard 1968):
scapula 17551 also from loc. 1945 (off at p. 15)

Prox. end tarsometatarsus 17552 and femur 17553 which were compared with

Sharktooth Hill tarsometatarsus, 16466 and femur 16465 (both discussed Howard 1966) *depth trochleae crest
of femur 16.6 mm*

check Broadbent 1961 (Luttrell) Eocene holotype prox. humerus 35.3 & prox. dist. depth 46.4
(see illus.) referred prox. carpal, & prox. scapula (b, neck 5.6)

CONCLUSIONS

Fossil bird bones are now available from two distinct levels in Tertiary deposits in Lawrence Canyon near Oceanside, ^{San Diego Co} California. Of 26 specimens from the lowermost level, 22--(representing nine individual birds)--can be assigned to four species of auks (family Alcidae) and a loon (family Gaviidae). The paucity of the material plus the fact that no bones of young individuals are present suggest an open ocean environment, ^{rather than a rookery}.

Two of the Alcidae are described as new, ^{a Murre} Uria paleohesperis and ^{a Guillemot} Cephus olsoni. Each is a first described species of its genus for the Tertiary of California. Both genera, however, were tentatively recorded from the Monterey Formation (Late Miocene) of Orange County (Howard, 1978). ^{9-10 million yrs old} The genus Aethia, ^{an auklet here assigned to} ~~herein recorded~~ ^{without specific designation} though specifically unassigned, is also represented ⁱⁿ at two ^{Orange Co,} other localities in the Monterey Formation (Howard op. cit. and 1968).

Even more diagnostic of the Late Miocene is the genus Praemancalla. ^{occurrence of the} This mancalline auk, in which the wings were less highly developed as swimming paddles than those of its later relative, Mancalla, ^{is} known only from the Monterey Formation of Orange County. The species ^{Praemancalla has been two species, P. californica & P. wetmorei, both from} P. wetmorei, ^{is} recognized in the Lawrence Canyon deposits, ~~was described from the Monterey Formation in Laguna Niguel, Orange County.~~ (Howard, 1976).

In striking contrast to the avifauna from the lower level deposits ^{in Lawrence Canyon} are 13 avian bones ^{obtained} from the upper levels ~~of the Lawrence Canyon deposits~~. These bones are clearly assignable to the genus Mancalla, ^{the genus} a form typical of the Pliocene period. Those elements ^{from the deposits of So Calif & Cedar} which can be specifically determined show closest ^{similarity} relationship to ^{9d Basin Calif.}

SHARKTOOTH HILL SPECIMENS OF ANSERIFORMES

- 3 Presbychen abavus Wetmore 1930
Wetmore recorded + H+ Holotype distal end of tibiotarsus USNM 11973 (Wetmore 1930)
Referred proximal end of tarsometatarsus LACM 16466 (Howard 1966)
Referred (questionably) proximal fragment of femur LACM 16465 (HH1966)
- 5 New genus and species to be described
X Holotype nearly complete tibiotarsus LACM 123991 (locality 4956)
XX Referred left and right femora LACM 123992 and 123993 (locality 4956)
X Questionably referred prox. and dist. fragments tibiotarsus UCMP 93051 and 93052 locality UCMP V71013
maybe Questionably proximal 3/4 humerus UCMP 93050, loca. UCMP V71013
- 6 Additional specimens in LACM collection
X Proximal end of humerus LACM 122979 loc. 3162 (resembles UCMP 93050)
X Proximal end of humerus LACM 123995 loc. 4956, doubtfully associated with tibiotarsus and femora 123991, 123992, 123993. Parts preserved not the same as those of other two humeri
X Femur lacking proximal end from LACM loc. 4956 (differs from those referred to new genus and species by slenderness of shaft, though bone as a whole is same general size. LACM 123994)
X Tarsometatarsus lacking distal end LACM 122981, loc. 3161. Suggests weak use of leg (differs from LACM 16466 referred to Presbychen)
Miller G. Proximal end of ulna UCMP 95970 loc. V6323 referred to Branta (Miller 1961)
maybe Proximal fragment tibiotarsus LACM 34530, loc. 1625 (smaller than proposed holotypes for new genus and species.)

ORANGE COUNTY LEISURE WORLD LOCALITY LACM 1945

- Referred to Presbychen (Howard 1968)
Proximal end of femur LACM 17553
Fragment of proximal end of tarsometatarsus LACM 17552
Scapula (LACM 17551 (lacks perforation))

ORANGE COUNTY MISSION VIEJO OSO DAM LOCALITY LACM

- Distal end of femur
Noted as a large diving anseriform possibly related to new sp. being described from Sharktooth Hill (Howard in press)
NOTE: Now find it more closely resemble Sharktooth Hill femur 123994 that has more slender shaft, though the bone length is large.

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1986

Anseriform bones in localities at Sharktooth Hill and Orange County

Sharktooth Hill

- ✓ Holotype Presbychen, distal end right tibiotarsus U.S.N.M 11973
- ✓ Hreferred Presbychen (Howard 1966) porximal tarsometatarsus LACM 16466 (loc. 1625)
- ✓ Referred Presbychen (Howard, 1966) Prox. femur LACM 16465 (loc. 1557) right
- Diving form observed by Morejohn (letter 1970) prox humerus UCMP 93050 (loc. 71013)
- Diving form observed by Morejohn (letter 1970) prox. frag tibia LACM-34530
- Holotype (to be) Diving form complete tibiotarsus LACM 123991 (loc. LACM 4956)
- Paratype (to be) Diving form left femur LACM 123992
- Referred (to be) Diving form right femur LACM 123993
- Referred (to be) Diving form dist. left femur LACM 123994
- Tentatively referred (to be) left tarsometatarsus LACM 122981 (loc. 3161) lacks dist
- Tentatively referred (to be) prox right humerus LACM 122979 (loc. 3162) (resembles UCMP 93050)
- Tentatively referred (to be) prox. frag. tibiotarsus LACM 34530 (loc. 1625) (seems very small)
- Unassigned prox. humerus LACM 123945 (loc. 4956)
- X Prox. ulna Branta (Miller 1961) UCMP no. 95970. loc. UCMP 9320 coll matched
- Unassigned dist humerus LACM 122980 (loc. LACM 3162)

Locality 1945

- X Assigned to Presbychen (Howard 1968) prox tarsometatarsus LACM 17552 (loc...)
- X Assigned to Presbychen (Howard 1968) femur LACM 17553 (prox) (loc.....)
- X Assigned to Presbychen (but smaller sp. than P. abavus?) (Howard 1968) Scapula LACM 17551 (loc.....)

Upper Oso Dam

Femur (distal end) ~~assigned~~ probably assignable to NSP. to be described from Sharktooth Hill LACM 125994 loc. LACM 4546

Prox. end ulna UCMP 95970 assigned to Branta by Miller (1961)

Studied 1986 by HH. Olecranon more erect than in either geese or swans most like Melanitta fusca (modern skeleton LACM 526) Suggests assignment to new diving form especially since the humerus is small also.

also D. consobrina and D. natator

NOTE Re: Jacques Cheneval (1982) assignment of the French (Milne-Edwards) species Anas blanchardi, ~~macroptera~~ and macroptera to Alden Miller's genus Dendrochen. His illustrations, however, of tibiotarsus shows that the internal trochanter crest is more medially set than in the new diving form from Sharktooth Hill. Furthermore, Miller's illustration of the type humerus of Dendrochen robusta (genotype of Dendrochen) has the prominent head (well undercut) which is quite distinct from the humerus (no undercut) of the Sharktooth Hill specimens.

Other specimens of anseriforms listed in Morejohn's unpublished ms

- ✓ Distal end of left tarsometatarsus ; (UCMP 86039) coll'd by Barnes 1968
- ✓ Dist. end left ulna (UCMP 88345) (coll'd by Barnes 1967. loc. UCMP 96842)
- ✓ Prox. end right humerus UCMP loc. V71013 coll'd by E.L. Anderson 1963 (is this the same as UCMP 93050 listed above? without loc. #?) YES

Probably not or he would not have listed it with Presbychen.

NOTE Morejohn discusses the dist and prox. ends of ulnae together prox. 95970 (Miller referred to Branta), dist. 88345 (has ill. of both)

→ Doubtfully anseriform. Try Megapalaeodus

1978 from localities in Orange County, in both of which the holotype humerus is smaller and has a more compressed shaft

than in LACM 120422.

June 1986

Previously described and/or recorded anseriforms from U.S. Miocene

UCMP 34456 holotype

Paranyroca magna Miller and Compton, 1939, Condor 1939: Vol. 41: 153-156
holotype left tarsometatarsus length 111.0 mm, br. trochleae 21.2,
least br. shaft 9.0. "Size of whistling swan and...specialized for
swimming and diving. ...paralleled diving ducks (Nyrocinae), shown in
lateral compression of distal end of tarsometatarsus (trend in this
configuration reaches extreme in grebes and loons)##"
Medial calcaneal ridge more rounded as viewed medially than in other
anseriforms; prox end of ridge continues smoothly into crest of internal
cotyla. Area on medial surface below internal cotyla depressed (due to crushing?)
Sma;;. ddp depression lateral to junction of calcaneal ridge
and internal cotyla unlike configuration in most other anseriforms.
2nd and apparently 4th calcaneal ridges (usual in Anatidae) lacking;
a broad, bipartite groove lies between medial and lateralmost (third?)
ridge. Lateral ridge somewhat sharper than in Anatidae and more laterally
deflected. Scars of ligamental attachments of lateral surface extremely
close to rim of cotyla. Most like diving ducks in this, though exact
configuration subject to individual variation. Anterior medial ridge of
shaft immediately distal to head not strongly concave as in scoters
and Chendytes, but straighter as in swans and geese. Proportions of shaft
and ends similar to those in swans and geese.
Condition of hypotarsus represents a primitive state--roughly equivalent
to that in screamers, suborder Anhimae, though the latter differ in other
ways.

OLD arrangement of Anseriformes as per 1957 AOU Checklist

Anseriformes

Suborder Anseres: Swans, Geese, Ducks

Family Anatidae: Swans, geese, ducks

Subfamily Cygninae: Swans

Subfamily Anserinae: Geese

Subfamily Dendrocygninae: Tree Ducks

Subfamily Anatinae: Surface-feeding Ducks

Tadorna, Anas, Spatula, Aix

Subfamily Aythyinae, Diving Ducks (= "Nyrocinae" ?)

Aythya, Bucephala, Clangula, Histrionicus

Camptorhynchus, Polysticta, Smoateris, Melanitta

, Oxyura (Note: Aythya WAS nyroca)

Subfamily Merginae: Mergansers

Lophodytes, Mergus

Miller and Compton do not give *Paranyroca* a definite subfamily designation but they say "...*Paranyroca* represents a distinctive and primitive anseriform family which may have some special phylogenetic relation with the Nyrocinae of the Anserifae. IT show more affinity to the Anserifae than does the Anhimidae and may be included with the former in the suborder Anseres. NOTE that neither 1957 or later Checklist use the terms Anseridae or Nyrocinae, so it is difficult to decide what Miller and Compton had in mind. Brodkorb places *Paranyroca* in the Anatidae: ~~Anatidae~~ and uses subfamily *Paranyrocinae* rather than full family designation as recommended by Miller and Compton.

Latest AOU uses following classification of Anseriforms:

Anseriformes: ~~Family Anatidae~~ Suborder Anseres: Swans, Geese, Ducks

Family Anatidae: Swans, Geese, Ducks

Subfamily Anserinae, Whistling-ducks, swans and geese

Tribe Dendrocygini Whistling Ducks: *Dendrocygna*

Tribe Cygnini: Swans: Genus ~~Cygnus~~ *Cygnus* (subgen *Olor*)

C. columbianus, *C. cygnus*, *C. buccinator*

Subgenus *Cygnus*: *C. olor*.

Tribe Anserini: Geese *Anser*, *Branta*, *Nesochen*

Subfamily Anatinae; Ducks:
 Tribe Tadornini: Tadorna
 Tribe Cairinini: Muscovy Ducks and Allies: Cairina, Sarkidiornis, Aix
 Tribe Anatini: Anas
 Tribe Aythyini: Aythya (scapularis)
 Tribe Merginini: Eiders, scoters, Mergansers, et al.
 Somateria (Eider, Polysticta (eider), Camptorhynchus (Aabrador Ducks)
 Histrionicus (Harlequin Duck); Clangula (Oldsquaw)
 Melanitta (scoter, Bucephala (Goldeneye and Bufflehead)
 Mergellus (smew); Lophodytes and Mergus Mergansers
 Tribe Oxyurini: Stiff-tailed ducks: Oxyura (Ruddy and masked ducks).

Measurements of holotype femur of *Cygnus senckenbergi* Lambrecht 1931
 length from intertrochlear area to proximal end adjacent to head 93mm
 breadth shaft 12 mm, breadth internal condyle 16 mm
 Trochanteric crest and linea aspera of femur less well developed than
 in *Cygnus olor*; bone only weakly pneumatic. Tibiotarsus with strongly
 developed supratendinal bridge.

Cygnus senckenbergi Lambrecht is from Hessler near Wiesbaden Germany
 lowermost Miocene (Aquitainian)

(Van Beneden) described by

Cygnopterus affinis Lambrecht 1931 has associated humerus, femur,
 prox. tibiotarsus, pto. scapula, head of coracoid, distal ulna.

Mid Oligocene (Rupelian) from Rupelmonde Belgium.

Femur length 86 mm, prox. br. 22 mm, shaft 10 mm (each measurement
 is slightly less than that of *C. olor* (*C. olor* length 92-107mm;
 prox. br. 22mm 29 mm, shaft br. 12mm)

Illustrations in shows external crest of tibiotarsus centrally
 located not at edge of shaft, as in divers and Sharktooth specimen

Measurements of *Chendytes lawi* and *milleri*

femur length *lawi* 65.7-76.4; *milleri* 59.4

Tarsus length 63.0-66.0 *lawi*; 58.2 *milleri*

Tibia prox. br. 14.8-15.5 *Lawi*; 10.8-13.0 *milleri*

distal breadth 13.3-14.1 *lawi*; 12.2-13.5 *milleri*

Short in Auk 87(3) 1970 p. 538 *Heterochen pratensis* Tarsus holotype L. Plio
 Nebraska Related to *Sarkidiornis*, *Plectroperus* *Chenonetta*.

LOOK FOR MT SKELETON FLIGHTLESS CORMORANT To examine tarsometatarsus
 ALSO EXAMINE GREBE and LOON TARS. Very different

The type of *Dendrochen robusta* n. gen and sp. is a humerus in which the
 head is undercut and also curves down toward internal tuberosity (as in
 Chen, whereas the humerus from Sharktooth Hill that is probably associated
 with the new sp. is not undercut and the edge is only moderately rounded.

IN BRIEF: Neither the tarsus of *Paranyroca* or the humerus of *Dendrochen*
 fits the material from Sharktooth Hill.

Henry D

How many
specimens
5 for them

Tibia of holotype of *Chondrytes*

Note Scapula from loc 1445
referred to *Philopachus* each foramen
thus differs from *Scelus*

same region posteriorly below base end - two longest ridges in "neck" area
not present in *Chondrytes*.

Ant. lvs shape more rounded in h. sp. - very flat in *Chondrytes*

dist { 13.3 12.8 - B11925
13.6 br x 12.8 depth *Chondrytes* holo. cast
18.4 h 16.4 " n. sh

9.9 intercondylem n. Sp Shachibath

7.6 *Chondrytes* B11975 intercondylem depth

8.3 *Chondrytes* holotype cast " "

$$\begin{array}{r} 87 \\ 143 \overline{) 11600} \\ \underline{1464} \\ 1360 \end{array}$$

$$\begin{array}{r} .92 \\ 100 \overline{) 920} \\ \underline{900} \\ 200 \end{array}$$

$$\begin{array}{r} 82 \\ 322 \overline{) 2658} \\ \underline{2576} \\ 740 \end{array}$$

$$\begin{array}{r} 88 \\ 145 \overline{) 1280} \\ \underline{1160} \\ 1200 \end{array}$$

$$12.4 : 11.5 = 9.27 X$$

$$12.4 X = 114.8$$

$$X =$$

$$\begin{array}{r} 89 \\ 446 \overline{) 3986} \\ \underline{3568} \\ 4180 \end{array}$$

$$\begin{array}{r} 12.4 \\ 12.4 \overline{) 114.08} (9.2 \\ \underline{111.6} \\ 240 \end{array}$$

$$\begin{array}{r} 50 \\ 252 \overline{) 2026} \\ \underline{1260} \\ 766 \end{array}$$

$$\begin{array}{r} 87 \\ 88 \overline{) 770} \\ \underline{704} \\ 660 \\ \underline{616} \\ 44 \end{array}$$

$$8.5 : 7.8$$

$$12.4 : 11.5 = 8.57 X$$

$$12.4 X = 97.75$$

$$X = 7.8$$

$$\begin{array}{r} 91 \\ 127 \overline{) 1170} \\ \underline{1043} \\ 1270 \end{array}$$

$$\begin{array}{r} 11.5 \\ 11.5 \overline{) 85} \\ \underline{85} \\ 0 \end{array}$$

$$\begin{array}{r} 84 \\ 110 \overline{) 930} \\ \underline{880} \\ 500 \\ \underline{440} \\ 600 \end{array}$$

$$\begin{array}{r} 920 \\ 124 \overline{) 9775} (78 \\ \underline{868} \\ 1095 \\ \underline{992} \\ 1030 \end{array}$$

$$\begin{array}{r} 87 \\ 88 \overline{) 778} \\ \underline{704} \\ 660 \end{array}$$

Hummer	re	Tibiae	Cygnus columbianus	large	#1746	Ternall	#1439
1746	1439	holotype. smaller for.					
tibia sh.	11.0	84% 9.3	8.8	81% 7.7	123991	123991	93052
Hummer	25.7	80% 22.8	14.5	88% 12.8	123992	123992	93052
depth	14.3	88% 12.6	10.0	92% 9.2	123993	123993	93052
br sh over	18.3	87% 16.0	12.7	99% 11.7	123995	123995	93052
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Measurements Aug 20, 1983

123994 of 5 specimens
OSO C. Col umbraus

988 1074
coln B. can.
918 1674

	123993	123992	123994	1475	1439	988	1074
Length (ext.)	81.0	75.4	174.6	99.0	93.8	97.9	89.1
Length (int. to valley)	75.4	77.4	105.7	91.8	84.8	88.5	78.5
Length (int.)	—	—	95.4	94.5	87.6	91.0	81.9
8/10 br / depth shaft	9.5/8.4	9.1/8.6	7.7/10	10.5/9.8	10.7/9.7	11.2/9.6	9.0/7.8
Distal breadth	—	21.8	20.5	24.9	24.6	25.5	22.0
Depth (prox. end/ext)	15.2	14.2	—	19.7	19.6	18.4	20.4
Breadth prox. end	21.6	—	22.1	—	—	—	—

femur # 123994 br 7.546 OSO
123994 br 4.956 Shankbone



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Cygnus olor range in size

Length of tibia. 4 mm range

(small range 66)
4 thurs.

length tibia small	174.6	C. col.	17439	Columbian	174.6 - 201.6
length tibia small	201.6	C. columbian	381	"	"
length tibia overall	151.8	#123991			
C. col.	1136.7	Chondypter holotype cast			
"	126.7	ref " from (Edwards?) 1811978			
"	172.2-176.2	Cygnus olor #69 and 1096 smaller range of 3 specimens			
gr. br. prox	134-144	# V71013/93051 and 123991			
	15.7-16.1	C. olor. 69 and 1096			
	19.6-20.3	C. columbian 1439 + 381			
least br. shaft dist. where shaft flattens ant-post'ly	8.5	# 123991			
	7.7	# V71013/93051			
an above C. olor.	10.9 -	# 69			
	11.1 -	# 1096			

Length femur C. olor 90.5 - 94.1
 (with) #69 + 1096 + found 79.4 found int found ext 80.8
 ext 69 - 10.96 - " 96.4 - 101.3

160
 71
 201.6
 160
 14.6
 174.0

C. olor - 69, 1096, 918
 C. col - 381, 1439, 1476, and 1747

more musc.
 "muscle" node" better than in Melanitta + more posterior
 more like Chondypter than more of a node
 Volition area in fossil here. Boiled out. ~~C. col.~~
 flange to fibular crest more gradual

femur of n. sh. stocky + archaic in n. sh. flange appears to
 T straight as in C. olor. ~~rocks over into posterior surface~~
 mounts

Tibia int. view area suggesting C. olor but more crest like at its
 distal extremity than in C. olor (protrudes more laterally as in Mergus
 but shaft rounded as in C. olor)

Femur has less decided rise running the ext side of the
 P. olecranon area; Thus more like the Ewan Cactinoid curves
 into the shaft on ext side - not raised into a ridge



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August 29, 1982 Measurements

Tibiotarsus

Breadth from
fibular crest
to inner cranial
crest [= from
prox. extent of fibular
crest to int. edge of bone]

Breadth distal end

Depth distal end

Depth distal int. condyle only

Breadth distally at level
of bulge X

Less Breadth shaft above
distal end

Holotype n. st 345341625

14.4

13.4

12.5

max 21.746

(min?) 17.74

min 14.39

18.7

16.0

15.0

93.90

86.40

85.50

84.90

1074
Breadth
can

n. st

Paritydian

93052

all
9.8

18.2

18.3

21.7

24.0

21.7

20.4 14.9

16.2

18.5

21.4

24.5

21.4

20.0 15.7

16.4

19.2

21.4

25.1

21.4

20.8 18.1

14.3

13.3

13.2

17.7

16.4

15.0

8.5

—

7.7

10.3

9.5

9.3 8.2

$$\begin{array}{r} 80 \\ 1847 \overline{) 1500} \\ \underline{1496} \\ 40 \\ 177 \overline{) 1496} \\ \underline{1493} \\ 3 \end{array}$$

$$\begin{array}{r} 192.2 \\ 143.3 \overline{) 1340} \\ \underline{1287} \\ 530 \\ 286 \\ \underline{340} \end{array}$$

$$\begin{array}{r} 186.1 \\ 144. \overline{) 12510} \\ \underline{1452} \\ 980 \\ 864 \\ \underline{116} \end{array}$$

$$\begin{array}{r} 187 \overline{) 1600} \\ \underline{1426} \\ 1740 \\ 1608 \\ \underline{132} \end{array}$$

$$\begin{array}{r} 187 \overline{) 1500} \\ \underline{1426} \\ 740 \\ 144 \overline{) 1340} \\ \underline{1296} \\ 440 \\ 432 \end{array}$$

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Measurements Aug 20, 1957

modern
C. columbianus

Humeral	123994	122979	93080	1746	1475	1439 (y9?)
Breadth shaft	12.3	11.4	11.6	17.0	16.5	15.9
below crest		92.6 ⁹⁰ 94.9 ⁹⁰		97.6 ⁹⁰ 93.9 ⁹⁰		
Ext Depth shaft	10.2	9.6	20.2			
through crest						
Depth shaft	8.6	8.5	9.1	14.9	12.4	13.2
inside crest						
depth eye shaft	11.5	9.8	7.8	20.0	19.7	19.0
to crest						

$$\begin{array}{r} 94 \\ 12.3 \overline{) 114.0} \\ \underline{1107} \\ 330 \\ 492 \end{array}$$

$$\begin{array}{r} 97 \\ 17.0 \overline{) 165.0} \\ \underline{1530} \\ 1200 \\ \underline{1490} \\ 100 \end{array}$$

$$\begin{array}{r} 1.93 \\ 170 \overline{) 1290} \\ \underline{1530} \\ 600 \\ \underline{570} \\ 30 \end{array}$$

$$\begin{array}{r} 92.6 \\ 12.3 \overline{) 1140} \\ \underline{1107} \\ 330 \\ 240 \\ \underline{840} \\ 738 \\ \underline{102} \end{array}$$

Meas C. oliv like
Betta cinctus crest

$$12.5 \overline{) 1150}$$

$$\begin{array}{r} 10 \\ 113 \overline{) 1235} \\ \underline{1130} \\ 1000 \end{array}$$

$$\begin{array}{r} 859 \\ 114 \overline{) 980} \\ \underline{912} \\ 680 \\ \underline{680} \\ 0 \end{array}$$

$$\begin{array}{r} 92 \\ 125 \overline{) 1150} \\ \underline{1125} \\ 250 \end{array}$$

$$\begin{array}{r} 110 \\ 180 \overline{) 200} \\ \underline{180} \\ 200 \end{array}$$

$$\begin{array}{r} 110 \\ 16 \overline{) 176} \\ \underline{160} \\ 160 \\ \underline{160} \\ 0 \end{array}$$

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7. Mongolian Beef	3.45
8. Almond Chicken	3.45
9. Chicken with Cashew Nuts	3.45
10. Chicken with Brown Sauce	3.45
11. Shrimp with Vegetables	3.95
12. Shrimp with Lobster Sauce	3.95
13. Shrimp Szechwan	3.95
14. Sweet & Sour Shrimp	\$3.95

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Mean Fibular fossil vs Cygnus col. and C. den.

A Breadth from fibula to cranial crest UCMF 93051 13.5; holotype

m. mongolian 14.4, Breadth at level of supratarsal bridge

UCMF 93052 13.3, holotype m. mongolian 14.5

do #918
do 69
do 1096

1439 columbus } of 5
1746 columbus } of 5

90/1308
638
90

90/1370
1720
1380

70/610
560
500

97/610
539
710

145/1330
1305
250

146/1340
1314
360

18.6/15.00
1488
120

170/15.70
1560
100

175/16.50
1575
750

Breadth from fibula to cranial crest UCMF 93051 - 13.5
holotype - 14.6

146/1350
1314
360
146
214

of 5 min, Cygnus columbus 1439 15.0
max " " 1746 18.6
of 3 min " do m 918 15.7 left 15.0 nt
do m 69 15.8 nt
max " 1096 16.0

Breadth distal at level of bridge

90% 94%

mm C columb. 1439 15.7
max " " 1746 17.0
min C do 918 16.5 left 16.0 nt
69 16.8
1746 17.5

Breadth ^{depth} shaft from dist end

UCMF 93051 — 7.7/6.1
holotype 15% larger in 9.0/7.0
15% " depth
UCMF 93051 — 7.9/7.0
holotype — 7.7/7.0

Ratio depth to bread

Breadth at level of bridge

14.5/13.36
1305
250
145
105

UCMF 93052 13.3
holotype 14.5

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ANSERIFORM HUMERUS

WING BONES

July 3, 1986

Comparison of humerus

sp?
humerus
L 123995

L 122979

L 123230
UAMP 93050 +
cast 50019

L 123230
UAMP 93050
L 123230
UAMP 93050
L 123230
UAMP 93050

Branta canadensis

Breadth of shaft
below deltoid crest

12.5

11.4

11.1

12.3

q. Breadth from bicip.
crest to deltoid crest

34.7

28.5? (projected)

26.3? projected

34.3

q. Depth shaft

10.0

8.5

8.6?

11.3

Length deltoid crest

43.9?

38.8

39.5

47.3

UAMP 93050

In Nos. 122979 and 50019: The deltoid crest lacks the external
flange of the typical ducks and geese, but shows a palmar
suggesting the condition in Chondytes though to a lesser degree.

In No. 123995, however, the deltoid crest is ^{slightly} more externally beveled
though still less than in geese + swans + ducks.

The wide exposure in the area of the pneumatic foramina
in 123995 suggests the condition in the humerus of the
divine ducks though the prominent capital shaft ridge
is more like that of the swans. The contour of the acipital
crest is rather rounded suggesting Cygnus.

According to Woodfunder the ⁵⁰⁰¹⁹ reduction of the capital groove
evidenced in 122979 + ~~123995~~ and lack of undercutting of
The head is more like the geese + swans than ducks.
Also the capital shaft ridge is pointed toward the external
tuberosity rather than toward the head. However it is ^{more distinct}
ridge ^{more angular} than in ducks. The position of the capital shaft ridge is also like
Chondytes but I believe Chondytes has a more
undercut head.

Over

Comparison of humeri with other fossil auroreans
 Distinct from *Eremochela* (Pleocene of Oregon) in which the
 head is much more produced proximally and ~~base~~
 corner to a rounded point overhanging the groove, also
 very long & has a high well formed capital shaft ridge.
 Only the *carponotacanthus* and distal *taurochabacanthus* are
 known for *Oxyphronesa* *shotwelli* (Mergulie class.)
 ✓ check distal tarsus when specimen of distal tarsus
 from Bonched in Kien County comes from U.C.M.P.
 width through trochlear given as 8.0 mm.
 [seemingly less than specimen *Mergulie* drew outline
 of - from Bonched]

123995 humerus



broken
 high point
 on shaft
 depth line 9.6
 from anterior
 surface
 not including
 deltoid crest
 same meas in
 B. can. int. 11.2

apex extends

1 Deltoid crest to Bipital crest 34.4 mm

Then deltoid extends toward shaft and
 recedes onto palmar surface

Tho the above meas is the same as B.C. with
 the crest in the latter does not curve palmed
 thereafter as it does in the former

(Same meas. 100 in
 B. can. int.)

I am in the process of re-studying

Dear Howard:

Dr. Howard Hutchinson
 Museum of Paleontology
 University of California
 Berkeley, California

3142
 122999 of B.C. 2.8
 122999 of B.C. 2.8
 0.6 of B.C. 2.8

July 2, 1986

① *Conpaunus modestus* Senna with n. sb., from ST 140

Ayllia annuicornis B19203 #8476 ♂ Distal knee br. sb., depth 8.3 intercondyle
ext. epicondylar crest well prox. to fibular crest tho placed rather far extensl
TIBIA int. " " Lateral, but not as much flared laterally

FEMUR shaft laterally compressed
fibular condyle not notably extended externally
popliteal area deep + slender (slenderness caused probably by reason
of lateral compression of shaft)
Humerus capital shaft ridge to ext. side, very little excav. below head

Tadoma tadoma

TIBIA ext. epicondylar crest not far external
int. " " not at ext. edge
br. dist. end 10.8; depth int. condyle 11.2

NO *Geru* Popliteal area very small shallow
fibular condyle not well extended laterally
shaft br. 6.2 depth 5.4 wide

Humerus capital shaft ridge to ext. side, no undercut of head

~~*Santachiuma melanota*~~ (NOTISE in Box)

NO *Ferun* no flare of ext. condyle or fibular condyle
popliteal area shallow + small
shaft br. 5.2 depth 6.3

Humerus Capital shaft ridge far external - only slight undercut of head

NO *Netta papzara* #89947 = B11830

rockard TIBIA Both epicondylar crests very short, shaft rounded
distal bridge high (3.5 mm) + nearly straight
br. dist. end 4.5, depth 6.2

FEMUR Ext. + fibular condyles not extended
popliteal area small + shallow sh. br. 7.7, depth 7.6
trochantal developed anterior + bending into ant. surface

HUMERS Capital shaft ridge prominent - head undercut

DENDROCYGNA Bicoloratus B16887 (= B17499)

NO TIBIA int. not at edge bridge high (2.8 mm)

NO FEMUR small popliteal area

NO HUMERUS capital shaft ridge like head not undercut

ORYZOPEA ~~FRASATIARA~~ frubata ♂ 86501 (= B15533)

TIBIA int. epicondylar crest well lateral, ext. crest continues below fibular crest
br. dist. end 7.9, depth 6.8

NO

FEMUR Very curved shaft both laterally + fore/aft (br. 3.1, depth 4.1 shaft)
fibular crest extended laterally but only at extreme distal part (sudden
popliteal area small but deep (int. edge less developed than ext. edge
opposite is true of n. sb. at ST 140)

HUMERUS Cap. shaft ridge far external, head undercut

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ga

Measurements of tibiotarsi and humeri (in mm)

	Holotype	# 93052	%BA	5 specimens
Tibiotarsus				Cygnus
breadth distally	14.55	13.2		columbianus
at level of bridge	14.55	13.2	90%	17.8 - 16.0 % 87
Humerus	#123995	93050	% 122929	5 specimens C.columb.
BREADTH SHAFT BELOW		holotype		
deltoid crest	12.5	11.76	98% 11.4	18.0 - 16.0 % 88.8
		% of 123995	% of 123995	
		93.6%	91.1%	
		92.8% for both		

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Measurements of *Megalodytes* sp. *fibro larsia* compared with *thalotyph* genus.

	max. may 34530 USNM 93051 93072	holotype	type chrydys	C. col. 5 specimens
Br. from internal crest to fibular crest	12.5	13.3	14.7	15.0 - 18.8
Br. at bndg	13.2	14.0	14.3	16.0 - 17.8
Shaft br/dept	7.7 x 6	9.2 x 7.1	6.4 x 4.6	8.7 x 9.0
Br. from fibular crest	13.3	14.7	14.7	16.3

Meas. humerus

	123995	93050	122929	C. col. 5 specimens
Br. sh below deltoid crest	12.5	11.7	10.4	18.0 - 24.0
	93.670	91.170	123995	160 - 88.8%

Although the breadth of distal end (through bndg) is not so
noticeable - the shaft is notably narrower in 93052
Cannet meas. shaft in max. frag.

$$\begin{array}{r} 9.2 \overline{) 77.00} \\ 184 \\ \hline 186 \\ \hline 240 \\ 276 \\ \hline 640 \end{array}$$

$$\begin{array}{r} 9.2 \overline{) 77.00} \\ 184 \\ \hline 186 \\ \hline 240 \\ 276 \\ \hline 640 \end{array}$$

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$$\begin{array}{r} 100 \\ 84 \\ \hline 16 \end{array}$$

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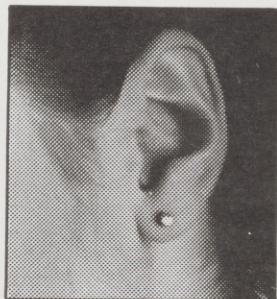
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MEASUREMENTS

FEMORA

FEMORA

Length from iliac facet to intercondylar fossa br to depth shaft

123993 123992

123994

75.4 75.4

~~xxx10~~

9.5/8.4 9.1/8.6

8.0/10.0

TIBIOTARSI

M. morejohni

M. sp.

Presbychen

SP?

Cygnus

Length

Br. distal end 18.2

18.3

24.0-21.7

Depth distal end 16.2

18.5

24.5-21.4

Depth int. condyle 16.4

19.2

25.1-21.4

Br. level bridge 14.3

13.3

~~13.3~~

Least br sh (dist) 8.5

7.7

~~xxx7~~

HUMERI

123995

122979

93050

Cygnus

Breadth shaft

below crest

12.3

11.4

11.6

17.0-16.5

Depth shaft

not includ.

crest

8.6

8.5

9.1

Depth shaft

~~xxx~~ to crest

11.5

9.8

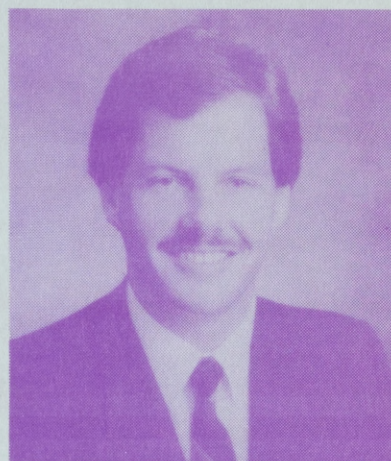
9.8

20.0-19.7

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VCMR
tibia
only
34530female
92930
VCMR
tibia
only
345301746
max 1439
max 1439

	12,0	13,4	14,5	13,4	12,4	16,2	15,6	18,2	16,0	15,0
Tibia										
Pr. enucleated	12,0	13,4	14,5	13,4	12,4	16,2	15,6	18,2	16,0	15,0
crest to fibrocr.	7,4	8,1	7,1	6,8	5,8	9,4	9,4			9,4
Depth to condyle	16,3									
Gr. br.	16,3	14,2	18,2	18,3	X	22,4	22,8	24,2	20,7	
dist end of condyle	16,3	14,9	17,0		X	21,8	23,1	24,7	20,9	
depth int condyle	16,2	16,0	16,4	19,2	X			21,3	9,4	
br shaft	7,7	8,3	8,7	7,7	X	11,1	10,7	11,9	15,6	
above distal end of shaft	12,0	12,5	14,4	13,7	X	12,7	16,6	16,9		
to dist through bridge										
Ulna										
prox breadth	16,2	16,4	9,8	8,3	16,0	23,0	22,7	24,0	19,7	
depth int. cotyle	15,1	14,2	9,0	8,0	15,0	18,2	18,4	21,1	16,2	
to olecranon	15,6	15,3	9,8	8,3	15,9	18,6	19,3	22,5	16,7	
depth prox end										
Gr. br. prop.										
Humerus	33,8	33,4-39,3	34,2	12,0		20,7	20,9	20,4	19,9	
prox breadth (dist end of shaft)	13,4	16,8-15,6	14,0	12,0		12,4				
Breadth shaft only	12,3	19,2-13,5	12,4	11,7		11,4				
below crest										
depth shaft										
above end of shaft										
not including crest in depth meas	11,3	12,5	16,2	10,1		14,6	15,5	14,6	13,9	
Femur										
Length least	72,0	78,4	75,3	78,1		91,4	86,5	95,4	85,0	
br sh mid	7,8	9,0	9,4	9,4		11,5	12,4	12,4	10,8	
depth same place	7,6	7,8	8,8	8,4		9,4	9,6	10,9	9,8	
Distal breadth	26,2	22,3	22,0	22,0		26,6	26,0	28,0	24,7	
Prox. breadth	20,3	24,3	22,0	22,0		27,9	27,1	27,4	25,5	
from to humer										
prox depth	16,3	19,2	17,3	15,2		19,1	21,7	20,5	18,1	
to achilles										
Tarsometatarsus										
Breadth prox end										
Ulna has the straight shaft of Cygnus										
but as A. high, shows olecranon suggestion of Melanitta										
Shaft straighter than Branta + olecranon also more erect										

female

-18,2 (see holotype for dist. above)

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